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*LIBRARY OF USEFUL KNOWLEDGE.*

# USEFUL AND ORNAMENTAL PLANTING,

WITH

## AN INDEX.

*PUBLISHED UNDER THE SUPERINTENDENCE OF THE SOCIETY FOR THE DIFFUSION OF USEFUL KNOWLEDGE.*

LONDON:

BALDWIN AND CRADOCK, PATERNOSTER-ROW.

MDCCCXXXII.

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# PLANTING.

THE subject of planting may, with propriety, be divided into three parts: useful or forest-tree planting, ornamental or garden planting, and orchard or fruit-tree planting. Each of these divisions of the subject, from its importance and interest, in a national point of view, as well as to individuals, seems to demand a distinct treatise.

The first of these, forest-tree planting, is proposed for the subject of the following pages; and the details of the theory and practice of the art discussed under the following heads:

I. Of some of the advantages resulting from judicious planting.

II. Of the structure of trees; and of the natural agents which influence and govern the growth of the plant from the period of germination to its full maturity. Of the seeds of forest-trees; and of the processes of vegetation.

III. Of the different modes of rearing forest-trees:—by sowing the seeds on the spot where they are to remain for timber; of sowing the seeds on nursery beds, and afterwards transplanting the young plants to their timber sites; by preserving and training proper shoots or suckers, produced by coppice roots or stools. Comparative advantages and disadvantages of these different modes. Of simple and of mixed plantations.

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V. Of the most approved modes of preparing different soils for the reception of the plants: fencing, draining, ploughing, trenching. Of the formation of rides or carriage-ways into the interior of plantations. Of the best mode of covering these with herbage.

VI. Of the culture of plantations: soil, pruning, thinning. Remedies for accidental injuries, and natural diseases of forest-trees. Seasons for felling trees. Of the tannin in the bark of different species of trees.

VII. Of the progressive increase of the size or produce of wood in different species of trees. Of the mode of valuing plantations: present value; prospective value. Of the products of plantations. Of some individual trees which have attained to great perfection. Of the terms used to denote certain products of plantations.

VIII. An enumeration of the different species: those of large growth, those of under growth for copse wood, ornament, or shelter. The generic botanical characters. Their natural soils; mode of propagation; and the uses to which their timber is more generally applied.

## Chapter I.

### *Of some of the Advantages resulting from judicious Planting.*

Judicious planting and the skilful culture of plantations combine national and private interests in an eminent degree; for, besides the real or intrinsic value of the timber or ostensible crop, with other produce of woods, available for the arts and comforts of life, judicious forest-tree planting improves the general climate of the neighbourhood, the staple of the soil, as regards the gradual accumulation of vegetable matter, affords shelter to live stock, promotes the growth of pasture and of corn crops, beautifies the landscape, and thus greatly and permanently increases the value of the fee simple of the estate and adjoining lands.

If we turn to those soils emphatically termed wastes—exposed, elevated lands, moors, bogs, and sterile sands—composing so large a portion of the British empire, and naturally clothed by the lowest and least valuable products of the vegetable kingdom, the inferior grasses, mosses, rushes, sedges, ferns, and heaths—we find that upon them the more valuable domestic animals cannot exist. If we consider the reason why they are so barren, waste, and unproductive, when compared with other lands not more favoured by nature, and under similar circumstances of latitude and elevation, the cause will, in many instances, be found in the want of the shelter and shade of trees, and of the ameliorating influence which plantations exercise on ungenial local climates.

The essential, permanent pasture grasses cannot be established on naked exposed situations; but when assisted by the shelter of forest-trees they become permanent and productive. Plantations supply us with with fuel, with materials for fencing, enclosing, building; corn crops, soiling plants, and root crops are obtained in succession under their genial protection. Many thousands of acres now unprofitable to the owners and to the community, might, by judicious planting, be reclaimed, and rendered highly productive; and it may be safely affirmed, that there is hardly a spot of waste land in the kingdom so barren, which by the exercise of skill in planting, and selection of proper species of forest-trees adapted to the soil and exposure, might not be covered with profitable plantations.

Numerous instances might be cited from different parts of the kingdom where exposed and sterile lands have, by planting, been made capable of producing valuable arable crops and the best pasture grasses, and of rearing and fattening stock of improved breeds. This, in effect, is adding to the territorial extent of a country, to its wealth and strength, by conquest over the natural defects of local climate, soil, and exposure.

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## Chapter II.

### *Of the Structure of Trees, and of the Natural Agents which influence and govern the growth of the Plants, from the period of Germination until the Trees arrive at full maturity.*

Plants being living organized bodies, a just knowledge of the functions of their vital organs, and of the principal natural agents which influence their progress of growth to maturity, will be found a useful, if not an indispensable assistant to guide the practical planter in rearing trees in the most

judicious and successful manner. This part of the subject properly belongs to vegetable physiology; and as the limits of an essay do not allow of entering into minute details, we shall here only notice those leading features of the structure of trees, and those functions of their vital organs, which more immediately influence the practical operations of the planter. In considering the progress of vegetable life, physiologists have distinguished six principal parts of a tree: the *root*, the *stem*, the *branches*, the *leaves*, the *flowers*, and the *fruit* or *seed*.

The varieties of the root of forest-trees are characterised by the names of tap root, fibrous root, and creeping root, these may be considered rather as indicating particular states of the same organ at different stages of growth than as permanent or specific distinctions *.

The tap root is that which first appears on the vegetation of a healthy seed, and penetrates perpendicularly into the soil. From it issue numerous minute radicles; and as the proper leaves are developed, lateral roots or fibres are formed and sent out from the sides of the tap root, particularly at the point of junction situated between the radicle and stem.

As the plant advances in age the distinction of the tap root is lost, either by decay or by its taking a horizontal direction in common with the general mass of roots, and from which in a few years it is not to be distinguished. Other leading roots are frequently formed from the first delicate lateral fibres, which pervade the tap root, and sometimes from its extremity when it happens to divide into parts, which always takes place when the extremity comes in contact with a richer or more genial soil, or, on the contrary extreme when it meets with obstructions in its first or early descent from whatever cause, rocks, gravel, &c., or by injury from insects: if the tap root be taken from the seed leaves before the plumula appears, or before the development of the proper leaves, the young seedling dies; and, again, should the tap root be deprived of the seed leaves before the production and expansion of the proper leaves, no farther reproduction or growth takes place. The uses of the tap root, it will readily be perceived from these facts, are of great importance to the plant in its first stages of growth, and may be compared to the equally essential and important uses of the seminal leaves, at the same period; but its subsequent destruction does not, as it has been supposed, influence injuriously the ultimate produce or value of the tree.

Two or any equal number of trees, for instance, of the same age, of the like constitution, and reared on a soil of the same nature, the one from seed on the spot, the other being transplanted from a nursery bed, without, or with a portion only of its tap-root, will give results which prove that trees, when transplanted at a certain age and size, and in all other respects of culture under the same circumstances, produce timber in quantity and in quality equal, if not superior to untransplanted seedlings. Whether, therefore, to raise forest-trees from seed on the spot where they are to

* In practical planting, as well as in practical botany, the root is considered to be that part of a plant which is hid underground, and the varieties of it are characterized according to the shape and mode of growth, as bulbous, tuberous, fibrous, or creeping; these again are susceptible of subdivision as they vary from the type. In physiology, however, the fibres or radicles are alone recognised as the roots, as it is they only which take up the food of the plant supplied by the soil.

The tuber of the turnip, potato, &c. and the bulb of the hyacinth, &c. are properly reservoirs in which to deposit the food of the plant until wanted in season for the production of leaves, flowers, and fruit, or seed. Indeed, bulbs and tubers may be considered the plant itself in certain stages of its progress to maturity. A deciduous forest-tree in winter, when without its leaves, flowers, and seed, may be compared to a bulb or tuber, when destitute at the same time of these parts of a plant. Roots, in general, are also distinguished in practice as to duration, being annual, biennial, and perennial.

produce timber, or in nursery beds, and afterwards transplant them, is a question of mere expediency.

Where seeds of the kinds of forest-trees desired can be had at little cost; where the soil is friable, is in a perfectly clean state, and consequently adapted to the plough culture; where such animals as are destructive of seeds and young plants, as mice, rooks, and game, particularly hares and rabbits, are not likely to be greatly destructive; and where the cost of labour is not comparatively high, then sowing the seeds of forest trees on their timber sites, may be the best practice and be adopted with success. But where, on the contrary, these obstructions exist or are probable, transplanting select healthy trees from nursery beds, though the plants be deprived of their tap roots, will be found more economical in the first outlay, and in the subsequent cost of culture; and the most profitable, as affording a quicker return of profit in prunings and thinnings, and will produce timber in a less number of years from the time of occupying the land for that purpose.

The fibrous root is that which is most common to forest-trees. It consists of numerous divisions or bundles of fibres, furnished with minute spongeols, and nearly representing the divisions or ramifications of the large and smaller branches and buds of the tree.

The variety of creeping root is chiefly confined to those trees which have the roots running horizontally, as in some species of poplar, elm, &c.

The organization of the root is similar to that of the stem and branches, from the *pith* which forms the centre of the body to the *epidermis* which covers the bark. Each part may be traced in uninterrupted continuation, from the minutest radicle of the root to the extremity of the smallest branch or bud of a tree.

When a root of whatever kind is divided, its horizontal section exhibits three distinct parts, the *pith*, the *wood*, and the *bark;* and a transverse section of the *trunk* of the tree, or of a branch, exhibits exactly the same parts.

The *pith* forms the central circle of a *root, stem,* or branch: it is a cellular membraneous body of a silvery white colour. As the tree or root advances in age and the timber is perfected, the pith gradually loses its original spongy texture, the cells of which it is composed becoming more and more compressed until all appearance of it is lost in the wood, excepting that the concentric circle which it occupied appears whiter than the other annual layers. But although the pith thus disappears in the old, it still continues in progress with the young wood of the root, stem, or branches; and the periodical fibres or radicles of the former, and the buds or embryo branches of the latter, will on examination be found to originate from it. When a branch is pruned off close to a stem wherein, from age, the pith has disappeared for some distance above and altogether from below the origin of the amputated branch, no reproduction of shoots takes place in whatever season the pruning may be performed, but should a portion of the branch be left to the stem, from that buds and shoots will spring. It also happens that when a branch is pruned off close to a young healthy stem containing perfect and active pith, before or shortly after the completion of the midsummer growth, which usually takes place before the end of July, no reproduction of shoots follows the operation, but the efforts of the vital functions of the plant appear to be wholly directed to cover the wound with fresh bark. Should the pruning, however, be performed in spring before or shortly after the expansion of the leaves, or after their fall in autumn, a reproduction of buds and shoots ensues, and a slower progress in the formation of new bark is apparent.

The presence of leaves is essential to the growth of buds and branches, and consequently to that of the pith in these and in the roots; but the leaves are not otherwise necessary to the formation and growth of the fibres or radicles of the root, as these are produced in abundance when the plant or tree is leafless, and even during winter when the ground is covered with frost and snow, the reservoir of nourishment in the *pith* being probably sufficient for that purpose.

From these facts and others which might be brought forward, it is clear that the uses of the pith in the formation of buds in the branches of the tree, and of fibres or radicles in the root, and in the support of these during the first stages of growth, are analogous to the important functions of the seed leaves in the first stages of growth of the seedling plant. The pith of a radicle or fibre may readily be traced into that of the root, and the same is precisely the case in a branch with relation to the stem of the tree. The respective uses of these organs are only for the first and early stages of growth; and, after that, they may be lost without any apparent injury to the further progress of the parts in question: the cotyledons dry up and fall away as the healthy progress of the roots and leaves advances, and the pith disappears, or its identity is lost in the wood, as that part of the structure which surrounds it approximates to maturity. *

The *wood* stands next in order to the pith, it is formed of indurated vegetable fibre, and occupies the space between the pith and the bark; it constitutes the bulk and strength of the subject. The yearly growth or increase of the wood is defined by circular lines or concentric layers clear to common observation in a transverse section of any root, branch, or stem. The discriminating characters of the wood being more obvious in the stem, than in the root or rootlets, we shall consider it more particularly when mentioning the stem.

The *bark* covers the wood in every part of the tree, and is the most important organ of vegetable life, for the pith may be lessened, the wood may be partially or even wholly taken away, and, the leaves may be stripped off, and yet the tree may recover, but when deprived of its bark, the root, stem, or branch of a tree dies. It is therefore of the greatest importance to the practical planter, that the bark of the roots and of the exposed system of his plants should be preserved free from the slightest injury.

The bark when divided horizontally shews three distinct parts, the liber, or inner bark, which lies next to the wood; the cellular tissue, or parenchyma, which is distinguished in the bark of the exposed system of the plant by its fine green colour, but which is colourless in the bark of the root; and, lastly, the epidermis, or outer bark, which is the universal covering of every part of a tree.

* A scion grafted on a stock, and a bud separated from its parent shoot and inserted into the *bark* of another tree, may at first sight offer proofs going to invalidate the opinion of the important uses of the pith in the formation of buds and fibres; but before the scion and the bud are taken off, or are in a fit state for the purposes of budding and grafting, the pith of the parent stock has already performed its offices. The important experiments of Mr. Knight on this subject prove that the pith may be removed in part without effecting the general health of the tree, just as the cotyledons may be removed from the young plant after having established its root and stem, with a continuation of pith to originate new buds, or embryo branches and radicles. We often meet with roots, which from severe injuries by mutilation at an advanced age of the tree, or by the injurious effects of a damp ungenial soil at an earlier period of growth, have lost the entire substance of the pith and wood, and present the appearance of a hollow tube, have yet young fibres or radicles issuing from their sides and continued as in roots where the pith and wood is perfect; on examination, however, these young fibres may be traced through the bark into the hollow of the root, demonstrating the origin of the radicle from the pith.

On young shoots and stems the epidermis appears membraneous, or as a thin transparent membrane without vessels; but late researches, aided by powerful glasses, have shewn that it is partially furnished with minute retiform vessels, particularly in the leaves.

When casually displaced off young shoots it is reproduced with little apparent injury to the part, unless it happen on the annual parts of the tree, as the leaves and flowers. In old stems and branches the epidermis often attains to considerable thickness, becoming hard, rough, or granulated, as seen in the trunk of elm, oak, and most kinds of forest-trees, and in the trunk of the apricot, pear, &c., among fruit-trees. When in this latter state, the epidermis may be removed without injury, and, in some instances, it has been cleared away from these fruit trees with evident advantage to their general health and fertility *.

The parenchyma is composed of hexagonal cells, containing juice, which in the stems and branches is of a green colour, even when covered by a thick indurated epidermis; but in the root, as before alluded to, the juice of the parenchyma is colourless.

The inner bark consists of cortical layers, constituted of longitudinal fibres or vessels, which are supposed to return the sap from the leaves after their undergoing certain changes by the action of solar light, heat, and air. The medullary rays which pass from the pith to the cellular textures of the inner bark and parenchyma in a horizontal direction, appear to be the medium of a lateral intercommunication of sap and air throughout the entire structure of the tree†.

The green colour of the parenchyma depends on the exposure of its epidermis to light and air; for when a portion of the stem of a tree is excluded from light, as is sometimes done in planting when the tree is placed deeper in the soil than it stood before transplanting, the green colour is destroyed in that part of it which is covered with the soil, and which in course of time assumes the colour of the root; and, if much moisture exists in the soil and the tree be not young, the bark so covered decays, and the tree dies. Should the soil be dry, however, and the plant

* In 1813 the following trial was made to ascertain the effects of removing the rough, hardened epidermis from the trunk and limbs of a very large and aged Crassane pear-tree. The tree was trained horizontally on a west wall, the branches extended twenty feet on each side of the large trunk in the most perfect order. The stem was cleared of the *rough* epidermis entirely, and the branches on one side also were treated in like manner. The branches which extended on the other side of the stem, had only every alternate branch stripped of the rough, hardened epidermis. Previously to this, the tree had for many years ceased to bear fruit, except occasionally one or two at the extremities of the upper branches. The first season after the above operation, the foliage assumed a more healthy appearance on the decorticated branches, and in the course of the second year many fruit buds were formed, which afterwards produced fruit of very good quality. The branches which were suffered to remain with their hardened epidermis, continued barren. Adjoining to this tree was another of the same species, apparently of the like age and of nearly the same dimensions. In this instance every second branch was pruned off near to the stem, and young grafts of the crassane, colmar, brown beurrie, and St. Germain, united to stumps of those branches respectively. These grafts all succeeded so well that in four years from the period of grafting they had nearly attained to the length of the old branches, and produced full crops of fruit of a very superior quality. The old branches, which had purposely been left, remained in the same barren state as before. The branches produced from the grafts were superior at the end of the fifth year, in regard to health and produce, to the decorticated branches; and these last were in a like proportion superior to those branches which were left untouched. These facts go to prove clearly that the thickening and hardening of the epidermis has a very considerable influence on the health and fertility of a tree.

† It is contrary to every known law of the vital power, to suppose that any part of the structure of a living organized body can resist decomposition or decay, if it be cut off from a reciprocal communication with the circulating vital juices.

young, the bark in question is gradually converted into root-bark; during this conversion of the stem-bark to that of the root, the plant advances but little, if any, in growth, but exhibits an unhealthy appearance by the paleness of its leaves, and the weak growth of shoots. The same effects are in a great degree observable from the opposite error, of planting too shallow, which is when a portion of the root nearest to the stem is left above the ground. This exposed portion of the root-bark in time gains the green colour in its parenchyma; and although no portion of it is ever found to decay, as in the former instance, yet, for a time, the plant makes but little progress in the growth of wood: if a fruit tree, the effect appears to be to increase the formation of fruit buds, and to stimulate the functions of the tree to bear fruit. It may not be devoid of interest to remark here, that this is a more efficacious mode of inducing a free growing though barren fruit-tree to bear fruit, than any of those recommended for that purpose, such as *ringing*, or placing an iron ring round a branch to prevent the annual increase of bark on the space occupied by the ring, cutting the bark in the manner of a circular incision of a branch, dividing the roots, and by reversing the natural direction of the branches. It may be unnecessary to add, that the above facts point out the importance of planting every tree not deeper in the ground, nor farther out of the surface, than the root occupied in the soil previous to transplantation; most essentially when the produce of wood or of timber is the primary object desired.

The *stem*, *trunk*, or *bole*, constitutes the principal body of a forest-tree. It is the medium of communication between the root and the branches, leaves, flowers, and fruit or seed. By the exercise of this function it obtains its yearly increase of substance, marked by the white circular lines apparent on the surface of a transverse section of the stem of every species of forest-tree. By counting the number of these circles the age of the tree may with certainty be determined.

It was before observed that the structure of the root was similar to that of the organization of the stem and branches; but a more particular notice of the constitution of the wood was referred to this place.

A close examination * of a horizontal section of the wood of a trunk or branch of a tree, will exhibit two very distinct appearances.

1st. A series of white and shining laminæ, which radiate from the pith to the bark (*fig. b*, 1)†. These generally straight, or sometimes interrupted, lines are termed the silver grain or medullary rays of the wood. These vary as to size and arrangement, termed primary or secondary rays, continued in one straight line from the pith to the bark, or interrupted and broken in the course of their direction, according to the species of tree which affords the wood in question. They appear to be composed of cellular tissue, and to originate from the pith, or, in a word, are a linear lateral extension of that organ. These medullary rays are elastic and contractile, as is evident to every one who has observed the effects of the extremes of dry and of moist weather on the section of a felled tree.

2d. A series of concentric layers, or circles, termed the spurious grain. These consist of tubular vessels of smaller or larger diameters, arranged in lines or groups varying according to the genus and species of the tree to which the wood belongs.

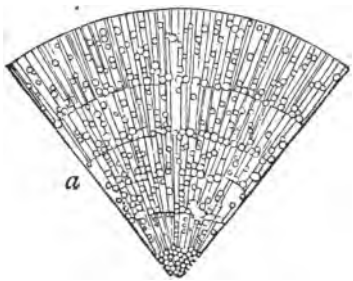
* With a common or four-power microscope. A thin slice of the substance is, perhaps, the most convenient for examining. When placed under a high magnifying power the beauty, order, and arrangement of the tubular and cellular texture will reward the observer.

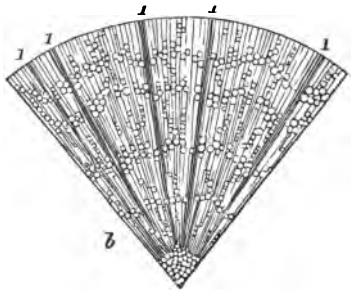
† These should be examined with a magnifying glass, for the texture of the different woods exhibited will thereby be more satisfactorily compared with the descriptions which accompany them.

An examination of many different kinds of wood proves that these characters of distinction are constant, and, therefore, afford a certain means of distinguishing the wood or timber of one species of tree from that of another.

The following discriminating characters of the woods of the principal timber trees will be found constant:—

The wood of the elm (*fig. a*) is distinguished by having the medullary rays, or silver grain, equal, and not crowded. The concentric layers are composed of a series of cells of nearly unequal diameter, arranged in an almost simple curved line. The spaces between the layers are furnished with cells of a smaller diameter, and rather thinly scattered over the surface.

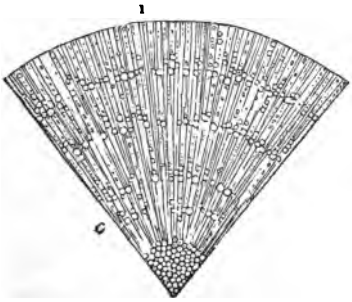


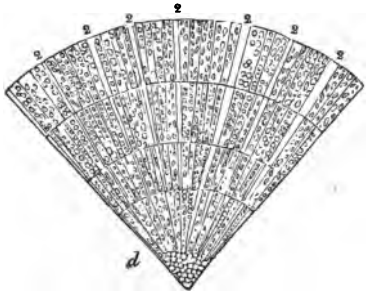




The oak (*fig. b*) has two series of medullary rays; the primary ones are large and strongly marked, distant from each other, and are uninterrupted in their course from the pith to the bark (*fig. b*, 1). The secondary rays are numerous between the primary, but not crowded.

The concentric layers, or circles, are distinguished by the arrangement of the cells. They are grouped in somewhat triangular masses, forming a wavy circular outline. The structure of the concentric layers or annual rings, distinguish at once with certainty the wood of the oak from that of the chestnut, with which it has often been confounded.

The wood of the ash (*c*) has the places of those rays so prominent on the wood of the oak, supplied by twin rays (1) placed in wide intervals over the surface, and between these double rays are smaller ones, placed in regular order. In the narrow spaces between the individuals which constitute the twin rays are wanting those apparent remains of the cellular texture which are so remarkable in the spaces between the single rays.

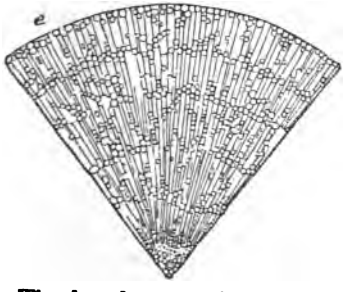


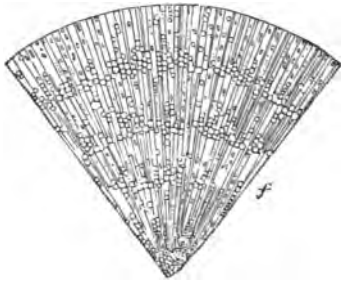




The wood of the beech (*d*) has the primary rays (2) dispersed pretty regularly over the surface of a horizontal section of the wood; the secondary rays are not continuous from the pith to the bark, but interrupted,

and exhibit a numerous series of fragments of rays, filling up the spaces between the primary ones, obvious to the naked eye, and rendering the silver grain, as it is called, of the beech very distinct from any other kind of wood.

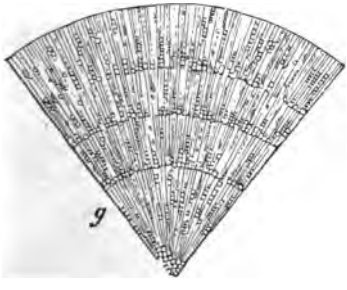
The wood of the Spanish or sweet chestnut (*e*) has often been confounded with that of the oak; but its characters of distinction are very obvious. It agrees with the oak in having the secondary rays equally disposed, almost straight, and, though close to each other, yet not crowded as in the elm and beech; it differs, in the primary rays being scarcely to be distinguished from the secondary, whilst in the oak these are prominent and obvious to the naked eye on the slightest inspection. The concentric layers are regularly curved, whilst in the oak they are strikingly waved. The mouths of the tubular vessels, which constitute so obvious a part of these annual rings, or layers, are disposed in triangular masses in the oak; on the contrary, in the chestnut they are in regular order.

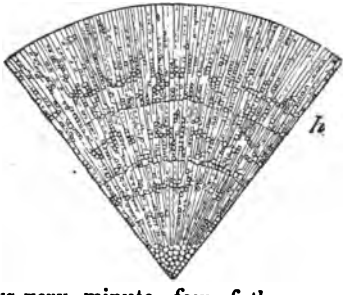



The hornbeam (*f*) has the rays of the wood nearly equal, but may readily be distinguished from that of the beech, to which it bears the greatest resemblance, by the simple arrangement of the tubular structure accompanying the concentric layers, which in the hornbeam are distant and oval shaped, the narrow sides pointing to the pith and to the bark; in the beech they are circular shaped, more numerous, and equal sized.

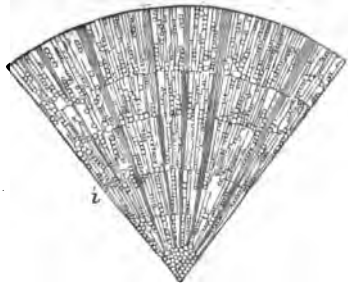
The birch (*g*) has all the medullary rays nearly equal, arranged closely, and having the concentric circles minute, but marked with a row of equal cells.

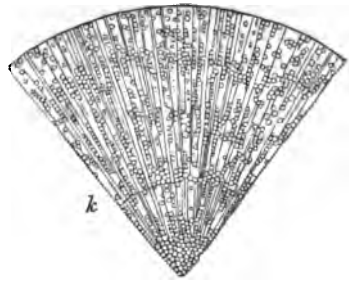



The horse chestnut (*h*) has all the rays very minute, few of them apparently continuous, but interrupted, and in substance varying in breadth. The cells are numerous and minute.

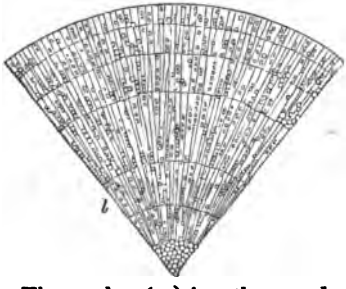
Alder (*i*) has the wood with large primary rays, thinly arranged, but in nearly regular order; the secondary rays are slender, numerous, and interrupted. The cells of the concentric layers are nearly regular. The spaces between the rays are crowded with cells.

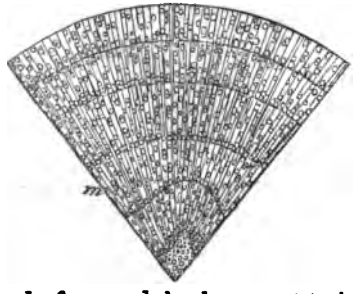



Oriental plane (*k*) has the primary rays regular but closely arranged; they are somewhat wavy; the cellular texture of the concentric layers but slightly marked.

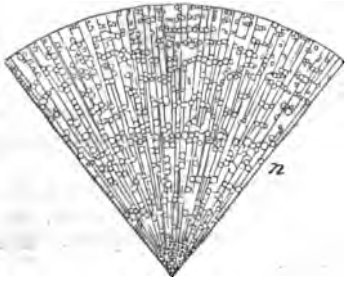
The sycamore (*l*) in texture approximates to the plane: still, however, it is very distinct in its straight lined rays, which are very minute or slender. The cellular texture is composed of such minute cells as scarcely to be perceptible under a four power microscope; these cells are, however, very numerous.

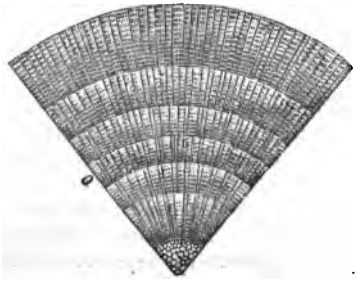



The poplar (*m*) has the wood composed of rays so slender as not to be obvious to the naked eye. The concentric layers are composed of exceedingly minute cells. This wood is extremely porous; the cells of which it is composed are so numerous that a very thin slice of the wood, taken horizontally, exhibits the appearance of the finest possible open net-work.

Common acacia, or locust, (*n*) has wood which bears some resemblance to that of the oak; but it is very distinct from any other kind mentioned here; it wants the distinct primary rays so prominent in the oak, the rays of the locust being all nearly of equal breadth, and as slender as the secondary rays of the oak; here they are somewhat wavy. The cellular or tubular structure is also very different from that of the oak, being

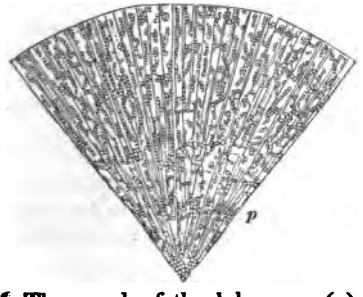


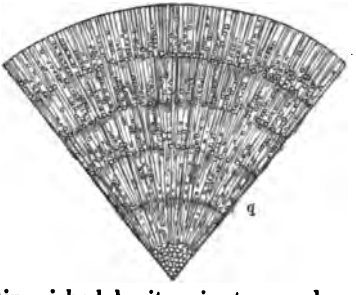



arranged in more regular order where they mark the concentric layers, and the spaces between the rays are furnished with many cells irregularly scattered over, of a size equal to those marking the concentric layers.

The wood of the fir (*o*) is distinguished from all others here enumerated by having very prominent coloured concentric layers, arranged very regularly throughout; and the cellular texture, though composed of cells sufficiently large to be seen with the naked eye, is not to be distinguished without very close observation.

The lime (*p*) has very slender equal rays and a minute cellular texture pervading the whole body of the wood. The concentric layers are scarcely perceptible to the naked eye. It may be compared to the wood of the poplar, but the network-like arrangement of the cellular texture is not so obvious in the former; the presence of the rays in the lime distinguishes it at once from the poplar.




The wood of the laburnum (*q*) is distinguished by its minute, regular, uninterrupted medullary rays, and by the broken beaded longitudinal lines of the tubular structure.

These characters of distinction being permanent and constant in all these different kinds of wood, will be found useful in cases where it is desirable to ascertain the kind of timber which may have continued sound for the longest period in any particular building or situation, and the contrary where its duration has been limited *.

The *leaves* constitute one of the most important conservative organs of vegetable growth; for on the free and healthy exercise of their functions depend the life of the plant and its progress to maturity, to say nothing of that universal interest and pleasure which is afforded by the diversified beauty of their forms and tints. The green colour of the leaves of trees has been proved, beyond all doubt, to depend chiefly on the influence of solar light and atmospheric air. Almost every distinct species and variety of plant, in its most healthy state, has its own peculiar shade of green: the yellow-green tint of the foliage of a healthy larch, would in that of a pine, spruce, fir, and cedar of Lebanon, be certain indications of disease and decay. The dissection of a leaf shews that it is composed of vessels, cellular tissue, and an epidermis. The green part of a leaf is, in fact, a continuation of the parenchyma of the bark before mentioned; and the mid-rib and nerves of the leaf are a continuation of the conducting and returning sap, and air vessels of the bark and alburnum. The under and upper surfaces of the leaf may be separated in an entire state from each other. These appear to perform different offices; the under surface is provided

* It would be of the greatest utility to the interests of planting were registers kept of the kinds of timber used in particular buildings; also the age of the tree which produced it, when felled, and the soil and situation or climate, in which the trees were reared. Posterity would be grateful for such records of facts.

with numerous minute pores by which moisture and air are emitted and absorbed. The upper surface of the leaves of trees is supposed to be destitute of pores: this part always turns its surface to solar light*.

The leaves of forest-trees are either simple or compound; simple as in the common beech, and compound as in the ash, where several smaller leaves are attached to one foot-stalk. The foot-stalk of the leaf is terminated by a gland, which in deciduous trees, or those that shed their leaves in autumn, becomes indurated, and at that season readily separates from the branch or twig.

The midrib of the leaf is merely a continuation of the footstalk; this divides the body of the leaf longitudinally; it may be compared to the stem of the tree, for from it issue branches of various sizes, dispersed through the substance of the leaf in order resembling those of the tree. The first or largest series of fibres issue from the sides of the midrib, either in an opposite direction, alternately, or irregularly, according to the species of tree; from these secondary branches proceed a third and a fourth series, not however in such straight lines as in the former, but curving and anastomising, or opening into each other in all directions, and, in this last particular, they have a resemblance to the disposition of the minute blood-vessels of the animal economy. The difference in the disposition of the first and secondary fibres of the leaves is so constant in the individual plants of different natural genera, that it affords a very clear discriminating character by which they may be distinguished from each other, in the same manner as the wood of different kinds are identified by the concentric circles and medullary rays before mentioned.

The leaves of the oak (Quercus) have the secondary fibres few in number, and curved towards the sinuosities of the leaf; the third series of fibres are very prominently marked, and the fourth series extremely minute. The leaves of the Spanish chestnut (Castanea), belonging to the same natural order but to a different genus, have the secondary fibres nearly straight, the third series very numerous and curved alternately, the fourth series nearly as large as the third, and if we examine and compare the wood of the oak and the chestnut, we shall find equally marked distinctions between them.

In the beech (Fagus), which likewise belongs to the same natural order, but to a different genus to the above, the secondary fibres of the leaves are very prominent, and the third and fourth series minute, and of nearly an equal size, and the texture of the wood is equally distinct from that of the oak and the chestnut.

That the leaves of plants during the day emit oxygen gas or vital air, and absorb carbonic acid gas or impure air, has long since been proved. In the night or during darkness, vital air is absorbed by plants and unhealthy air emitted, and it would appear by various experiments on this important point, that when the supply of carbonic acid gas from the air and soil is greater, the emission of oxygen gas by the leaves during their exposure to sunshine is also greater, hence another cause of healthy plantations improving the climate of their neighbourhood besides that of shelter.

The leaves of trees being the great organs for elaborating the sap and fitting it to become converted into all and every product of the tree, whether timber, bark, seeds or fruit, render the facts relating to their structure and functions of high interest to the planter and forester; for they point out the danger of lessening their number beyond a certain extent, as in excessive

* For a minute and interesting account of the varied forms of these pores, and of their number on different plants, see Part I. 'of Vegetable Physiology,' published in the Library of Useful Knowledge.

pruning, or of suffering the leaves to be crowded too much, so as to exclude a free admission of light and air, as happens when trees are planted too close together, and judicious thinning and pruning are neglected.

*The seeds of forest trees.* Seed consists of three principal parts: 1st. The *cotyledons*, or seed leaves;—2dly. The *rostel*, or first radicle, which descends into the soil, and becomes the root of the tree;—3dly. The *plumula*, which ascends, and becomes the stem, bole, or trunk. The rostel and plumula are closely united in the seed, and there constitute what is termed the germ, or embryo of the future tree. This is an essential part of the seed, for however healthy in appearance the seed may appear, if the germ be injured, the seed never vegetates. The cotyledons or seed-leaves contain a farinaceous substance which is the source of nourishment to the radicle, until established in the soil and fitted to perform its proper office in the development of the stem and proper leaves of the plant. It may be useful in this place to mention, that the seeds of forest trees may be classed under the following heads or general characters, indicating peculiar points to be observed in the practice of sowing them.

1st. *Seeds farinaceous, and covered with shells, nut-seeds.* To this class belong the oak, Spanish-chestnut, beech, horse-chestnut, walnut, hazel, hornbeam, plane, sycamore, maple, and ash, to which may be added, though not strictly belonging to the group, the birch, alder, and lime. The first seven kinds, from the farina they contain, are least adapted for keeping out of the soil, and the same cause renders them more difficult to preserve in the soil when sown, by inducing the attacks of mice, birds, and other vermin. The spring is considered the best season for sowing, and the seeds must therefore be preserved carefully during winter; the most approved mode is to spread them out in their layers on a cool dry floor, but previously to this they should be thoroughly dried by the sun and air. The smaller kinds of seeds after being sufficiently dried, may be kept in a smaller space. The seed of the oriental plane (*Platanus orientalis*), however, succeed best when sown immediately as it is perfected. When sown, these seeds require different degrees of covering in the soil. The larger seeds, as those of the chestnut, oak, &c., should be covered with two inches of mould; for the smaller seeds of the plane, sycamore, hornbeam, maple, and ash, it will be proper to mix with them sand, in quantity about equal to their bulk, placing the mixture on the ground a foot in thickness, and covering that with an inch thick of mould. The birch may be sown immediately as it is taken from the tree, or preserved in the seed-loft until spring. When sown, the birch is generally covered half an inch with mould, the former seeds with one inch.

2nd. *Hard seeds, or stones covered* with a pulpy fruit. The proper covering of these seeds is so hard, as to have acquired for them the name of stones. In this class are the cherry-tree, mountain-ash, whitebeam, yew, holly, pear, crab, and thorn. With the exception of the cherry-tree, all these remain in the soil one or two years before they vegetate. To obviate the irregular vegetation of these seeds, which is attended with loss of time and inconvenience, the practice of preparing them for sowing by what is called pitting has been adopted; this is done in the manner above mentioned for the hornbeam, plane, &c.; but as one, two, or even three years in the pit or preparatory bed are wanted for some of these seeds, it is requisite after they have lain a certain time in the pit to uncover them and turn them over, so as to assist in the separation of the pulp from the stones. Holly berries require one year at least to prepare them for sowing; mountain ash, whitebeam, yew, and ash lie one year; the cherry readily vegetates in the same spring in which it is sown.

3rd. *Leguminous, or bean seeds.* These, as regards forest-trees are confined to the common acacia, or locust-tree (*Robinia Pseud-Acacia*), the glutinous Robinia (*Robinia viscosa*), and the laburnum. These seeds vegetate freely when sown from the tree, but it is the general practice to preserve them until spring in a dry, cool place. When sown, they require to be covered with about three-fourths of an inch of mould. If sown too thickly, that is, less than one inch seed from seed, the plants soon injure one another and become diseased.

4th. *Light seeds.* Under this head we enumerate smooth elm, and mountain elm, the poplar, and the tree willows. These seeds being light, and separating freely from the tree when ripe, require care in collecting, as otherwise they are liable to be dispersed and carried away by the wind. They vegetate quickly and may be sown so soon as they are ripe. Spring however is preferred, as tender seedling plants are subject to injury from severe weather in winter. They should be covered to the depth of one fourth of an inch of fine sifted mould.

5th. *Resinous seeds* are those of coniferous or fir-trees. Their vegetative power when cleaned or separated from the cones, is not to be preserved if they are kept out of the ground for any considerable length of time, and they require particular care in sowing. The soil of the beds ought to be of a light sandy nature, enriched with the vegetable mould of decayed tree leaves, or well decomposed dung. If a proper quantity of the former manure be added, and well incorporated with the sandy loam above described, it will bring that soil to a suitable texture. The seeds are borne in cones furnished with scales of a hard woody consistence. The cones of the larch with much difficulty part from the seeds, and various means have been adopted to effect that object. The best is that of first opening the cone, or dividing it lengthways into two or four parts, then placing them on a kiln and drying by a very gentle heat until the valves begin to open, when they should be taken to a proper floor and threshed: the seeds may then be separated by a sieve. The cones of the Scotch fir and the spruce require also the aid of the kiln; but the seeds part from the cones easily, and the splitting of the cones is superfluous. The spring* is the best season for sowing these seeds. The soil of the seedling beds should be in as finely a pulverised state as possible for their reception.

The seed of the stone pine requires to be covered with one and a quarter inches of soil, the silver fir and pinaster with one inch, the Weymouth pine with three-fourths of an inch; the Scotch fir, Norway spruce, balm of Gilead, and cedar of Lebanon with half an inch of soil. The cedar of Lebanon is best sown in boxes placed in a warm or sheltered situation. The larch should not be sown so deep; a covering of a quarter of an inch of soil suffices. The white, red, and American spruce firs, having smaller seeds, require a slighter covering of a fifth of an inch deep, and the texture of the soil should be even lighter, which can be easily effected by adding sand or a larger proportion of the mould of decayed tree leaves. Heath soil, or bog soil, containing a good proportion of fine siliceous sand, has been found very congenial to the vegetation of these seeds.† Shading

* If the winter happened to be favourable, and the depredations of vermin were completely prevented, the balance would be in favour of sowing the seeds of the fir and pine in autumn, and which would be the case also with every description of forest-tree seeds, the hard or stone seeds probably excepted.

† This description of soil has been erroneously supposed to be injurious to transplanted firs, and implements are used to remove the heath soil from the intended sites of the plants, in order that the roots may be inserted in the subsoil of gravel or sand, of which the subsoil almost always consists. The roots of the heath while alive are the cause of injury, not the nature of the soil.

from hot sunshine is highly beneficial to them, indeed, indispensable in some states of the weather, for the thin covering of soil which is necessarily allowed them is soon affected by the action of the sun's rays, and sudden drought quickly destroys the tender seedlings. The thickness in which the seeds should be sown, according to the respective kinds, is on an average from three to four on a square inch, so that the plants when produced stand not nearer to each other than that scale of distances.

The artificial fine state of culture of the soil in the seed beds, rendering it less retentive of the due degree of moisture than is required, the beds should be consolidated before and after the seeds are sown, either by the use of a roller, or by the spade.

In concluding this practical view of the structure of forest trees, and of those natural agents, which obviously influence the growth of plants, it may be useful to take a similar view of the process of vegetation. A perfect and healthy seed consists of an outer covering, cotyledons, radicle, and plumula. When sown in perfectly dry earth, it remains unchanged; if in an excess of moisture, it loses its vegetative powers and decays: in neither case it vegetates. When the temperature of the soil is below a certain point, all vegetation is suspended. Should the soil and the temperature be perfectly favourable to vegetation, yet if the seed be not planted shallow enough to be within the influence of atmospherical air, no vegetation takes place. Different species of seeds require different degrees of moisture, temperature, and atmospheric influence, to render their vegetation the most healthy and perfect. The natural constitution of different soils, as regards their respective properties of retaining or easily parting with moisture; the proper season of sowing, as regards the temperature of the soil and the atmosphere, by whatever local causes subject to be influenced; and the respective depths to which the seeds should be deposited in the ground, as above mentioned, apply directly to the skill of the cultivator to aid, modify, and assist these primary essential agents of vegetation; and on the right adjustment of these depend the success and just reward of the planter in this first stage of the process of his art.

In whatever position the seed is placed, the radicle first bursts the covering, and takes a downward direction into the soil, where it becomes fixed, and protrudes, at right angles from its sides, numerous rootlets, which in their turn emit others; then, and not till then, the cotyledons rise above the surface and expand, shewing the plumula or bud of the stem, which now advances in growth and unfolds the proper leaves. After the leaves are fully expanded, the communication of the pith with the buds, formed or forming, at the base of each leaf-stalk in the angle made by that and the stem, may be traced. The loss of either of these organs of the seed at an earlier period would have prevented farther growth; for if the cotyledons had been seriously injured or taken away, the radicle and plumula would have died; if the radicle had been removed, the same effect would have followed; or if the plumula had been taken away, the plant would have made no farther progress. But as soon as the formation of the germ of buds is effected, as now stated, the cotyledons may be removed; the summit of the stem and the lower extremity of the radicle may be taken away, and the plant will reproduce others. It is during the previous stage of growth that the attacks of insects prove so fatal to seedling plants, and require the utmost care of the planter; and hence also the greater care and attention that is demanded in the preparation of the soil for seeds than for the reception of transplanted trees. This also points out the danger of injury to the vegetating seeds, by disturbing the seed beds before the

plants are perfected. It is in these early stages of growth, that the foundation is laid for the future health, beauty, and vigorous growth of the tree. The fibres of the root, with the minute spongeols before mentioned, now imbibe and send up the food of the plant to the leaves, where being spread out to the influence of solar light, heat, and atmospheric air, it is elaborated and returned through the foot-stalk by the longitudinal vessels of the inner bark to the root, depositing in its course, or in conjunction with the original fluids of the cellular texture forming, the various substances and secretions peculiar to the tree. That the sap ascends by the longitudinal vessels of the alburnum, sap, or soft wood, and descends by those of the inner bark, seems to be proved by the experiments of Mr. Knight and others, who have more intimately investigated this part of the subject. That a lateral movement of the sap goes on at the same time, and in conjunction with the ascending and descending movement, appears equally certain*. Every individual leaf of a tree is furnished with its own particular series of vessels for the course of the sap, and not only prepares and elaborates the sap for the increase of substance of its own branch, but also for that of the parent stem and root. Hence it is that trees regularly furnished with branches from the base upwards have more tapering stems, than trees with branches confined to the upper half of the stem, the increase being equal, from the point where the branches begin, downwards to the root; or, in other words, whatever length of stem from the root upwards is destitute of branches, that part of it from the period of losing them increases in size equally throughout†. Without a just knowledge of this principle in the economy of vegetable life, the important process of pruning in the culture of forest-trees cannot safely be performed by the forester: that the sap never ceases wholly to move ‡ is evident in the increase of the roots and buds during winter when the plant is leafless; but its ascent is particularly distinguished for greater force and activity at two periods of the year, spring and midsummer. The ascent in spring is the strongest, and continues until midsummer, gradually diminishing in force as the new branches and leaves are perfected. This generally takes place about the beginning of July, when an apparent cessation of ascending motion in the sap immediately succeeds, and continues usually for the

* The sap in ascending is farthest removed from the action of solar light, heat, and atmospheric air, in descending it is nearest to these important agents, receiving their impulse through the medium of the green cellular tissue or parenchyma. The offices of this organ in transpiration and inhalation, may be compared to that of an universal leaf covering every part of the stem and branches of a tree.

† This fact may be demonstrated most conveniently, by pruning the lateral branches off quite close to the stem of a young fast-growing tree, leaving a certain number to form a top, and to keep up the growth of the plant.

‡ The term *circulation* has been objected to as improper for describing the course of the movement of the sap in plants; because a point from whence the movement begins, and to which it again returns (as for instance, the heart in animals,) has not been discovered in plants; for in these the sap is periodically exhausted in the increase of the substance of the tree, and its place periodically supplied from the soil to the spongeols of the roots. The term periodical is here understood to apply to the effects observed, by the practical planter, of the spring growth, midsummer growth, and leafless or winter cessation of growth, annually in the progress of every forest-tree. That the roots of these plants (as long as their vital powers continue to act) continue, *without intermission*, to imbibe fluid or pabulum from the soil, however small in quantity that may be at certain seasons, seems highly probable; as also that a movement or circulation of the fluids of the cellular texture, however languid it may be, exists even in the leafless tree. But there are plants, such as the hyacinth, potatoe, onion, &c. &c., which remain two or three months annually during their progress of existence, without a possibility of imbibing anything whatever by their roots, rootlets, or spongeols, inasmuch as during that period of their existence they are destitute of these organs wherewith to imbibe.

space of a fortnight or three weeks, according to the age of the plant and the state of the weather. A second ascent of the sap, and growth of shoots now take place, but with diminished vigour; unless from accident, disease, or unfavourable weather, the spring growth has been checked, and the first flow of sap prevented from being exhausted in the production of branches, leaves, and blossoms. It is worthy of remark, that those shoots which form fruit, flower, or seed buds, have seldom if ever any second growth; but remain without increasing in length until the next spring. The midsummer growth is almost always confined to those branches which carry wood buds only. After the second growth is completed, the effects of the descending sap in the formation of new bark and wood is very apparent in the healing up of wounded parts of the stem and branches, which now proceeds with more activity than during any other period of the year. Branches pruned off after the midsummer flow, seldom are followed by shoots from the edges of the wounds caused by their removal, which always happens, more or less, when pruning is performed on free growing trees after the fall of the leaf, and before the full development of the spring shoots and leaves: it is to be observed, however, that the reproduction of branches from the edges of a wound is greatly assisted by leaving a portion of the branch or shoot, or its parent branch or stem, but impeded when a branch is pruned off close to the stem. What was before stated regarding the offices of the pith and medullary rays in originating the buds of shoots and branches, will be confirmed by these facts.

*Food of Plants.*—Those substances which the roots of plants take up from the soil, and those which the leaves or green system of the plant inhale or imbibe from atmospheric air are comprehended under the name of the food of plants. This part of vegetable physiology has long engaged the anxious inquiries of science, as well as of practice. The question is one of much importance, inasmuch as a perfect knowledge of what constitutes the food of plants generally, and individually, would with unerring certainty point out the means of fertilizing soils, defective in any respect for bringing to perfection the species of tree most desired; would indicate at the same time the most proper substances to be used with the greatest advantage, the exact proportions in which they should be mixed, the mode of applying them, and the best process of manual culture or working the soil, for elaborating and preparing them for absorption by the roots. Of late years great progress has been made in the investigation of this part of vegetable physiology; the labours of T. A. Knight and M. Dutrochet are, in particular, highly valuable, but much still is required before even an approximation to the solution of this important question can be attained. The structure of the root shewed us that whatever kinds of substances are conveyed or by it introduced into the plant, such substances must be in a minute state of division, or dissolved in water. The analysis of a soil demonstrates the soluble substances it contains. These have been found to be chiefly vegetable extract, combined with smaller proportions of a few of the neutral salts, as sulphates of potash and lime, muriates of lime and soda, or common salt; this last, in every instance of our own individual experience, is always in a larger proportion to the other saline matters, and is never altogether wanting, as is the case sometimes with the sulphates and muriates of lime. The vegetable extract, except as regards its presence in poor clays and siliceous sands*, is always in a

* The soils here alluded to, the results of whose chemical examinations have led to the above conclusions, were of almost every kind or description to be met with in practice, comprising the various degrees of fertility intermediate between the poorest sand and the most tenacious clay.

larger proportion to the saline matters. It contains the elements of which the substance of a tree is composed, viz., carbon, oxygen, hydrogen, and azote. The extract, however, obtained from soils is never perfectly pure, but is always more or less (in all our experience) combined with mucilage, and frequently with soluble animal matters. In alluvial soils distinguished for fertility, the soluble extract is found in the largest proportion; five parts of vegetable extract in four hundred of the soil is considered the maximum for healthy vegetation.

The soils called alluvial have the power, it is evident, of preserving this substance in the decomposing vegetable matters which supply it, and of giving it out to the roots of plants, or rather to the water of the soil, slowly, but in that seasonable and regular manner which is the most conducive to the healthy exercise of the functions of the roots. It is evident that in some alluvial soils this extractive vegetable matter must have remained from a remote period uninjured for the purposes of vegetation *. In siliceous, sandy, and gravelly soils, the reverse of this takes place, for the manures applied to these is speedily decomposed, and the extractive matter given out, comparatively, at once: hence the constant repetition of manures required by these kinds of soil to keep them productive. When clay, mild lime, or chalk, fine siliceous and calcareous sand, and impalpable vegetable matters are so intimately combined as to constitute what is termed the best loam, the extractive matter, whether of long duration in the soil or in recently supplied manure, is economized and given out to water, and to the roots of plants, in a similar degree of effectiveness as in the alluvial soil: on the contrary, when clay is the chief earthy ingredient of a soil, the vegetable matter is either retained in the manure, or given out partially; the lower temperature of the clay, its great adhesive powers, and compact texture, uniting to produce this result †. The food of plants supplied by atmospheric air, whatever proportion it may bear to that supplied by the soil, is at least equally essential to the growth of plants, for they can no more exist without that, than they can exist without the soil. The curious structure of the leaves shews how admirably they are

* Extractive matter, when separated from the saline compounds with which it is usually accompanied in soils and in vegetable manures, and exposed to the air, soon decomposes or putrifies. It also loses its solubility in water after two or three solutions in and evaporations of the water. It is a constituent of the nutritive matter of the food of the larger domestic animals, but in the process of digestion it is not retained in the body of the animal for the purposes of life, but is voided with the fæces. The pasture grasses, corn, or annual grasses, green or soiling plants, as clovers, lucerne, sainfoin, vetches, turnips, mangel wurzel, and carrots, all contain extract as an essential constituent, which, with the woody fibre and saline matters of the vegetable, are returned again to the soil.

† The great benefit resulting to clayey soils from the process of paring and burning, is that of improving their texture, and, even in some degree, their temperature or latent heat. A certain degree of what may be called a circulation of the water and air of a soil is essential to its power of preparing the food of plants depending on the soil. Where this power is wanting, as in the case of a perfectly stagnant clay or peat, or a sandy soil, with a subsoil impervious to water, vegetable matter, however ample, in these soils will remain inert and afford no support to trees, or, at least, they will not long exist if planted under such circumstances. So obvious is the effect of this principle of circulation of water and air, (if we may be allowed the expression,) that some have undertaken to prove that the fertility of soils depended on it alone, and that water and air constitute the sole food of plants; and that even animal and vegetable matters were no farther useful than as contributing to the temperature and texture of the soil, fitting it for the more ready circulation of these, and more readily presenting them to the roots of plants. However erroneous the conclusion may be, the principle of practice inculcated by it is essential to the successful cultivation of trees, for on it depend the processes of paring and burning, draining, trenching, digging, and in a word the judicious adoption of the various means which are employed for pulverizing and comminuting soils.

fitted to imbibe air and moisture. The essential constituents of atmospherical air are oxygen and nitrogen or azote; and it holds in solution carbonic acid gas and water; they are elastic and invisible, but can be separated from each other, and their bulk, or volume, and weight can be determined, and their properties satisfactorily ascertained*. Oxygen has received the name of pure or vital air, because animals cannot respire if the air they breathe be deprived of it, nor can seeds vegetate unless it be present in the soil and air in which they are placed. It enters into the composition of the vegetable and most other acids, and largely into that of sugar and extract. It forms about one-fifth of the air of the atmosphere. Carbonic acid gas constitutes about a thousandth part of atmospherical air, its basis carbon is well known in the state of charcoal, and is the fundamental constituent of wood. Nitrogen, or azote, constitutes about four-fifths of the atmospherical air. Its offices have not been so clearly discovered: with much reason, however, it appears to be employed in the formation of several products of vegetation, as gluten and albumen, and in modifying the actions of the other components of the air. It is remarkable that carbonic acid gas being so largely produced by numerous artificial and natural processes constantly going on, as in the putrefaction of substances of every kind, in fermentation, combustion, respiration of animals, and, during darkness, by the green system of the whole vegetable kingdom, so small a portion only of it should be found permanent in the air, varying from $\frac{1}{500}$ to $\frac{1}{1000}$ part as the minimum and maximum. It is heavier than the other constituents of air, and it is lost from the atmosphere, or from wherever it may exist in plants only, and forms the bulk or basis of every kind of wood; it must be at present considered as being largely taken up by the roots of plants. Water, the last mentioned constituent of atmospheric air, enters into it in the state of vapour. The quantity of it suspended in the air is supposed to

* The elasticity of the constituents of atmospheric air is so powerful, that when, from local causes, one ingredient is generated in undue proportion to the others, the most perfect analysis of the general air in the immediate neighbourhood of the spot where this circumstance happens cannot detect any difference in the proportions of the proper constituents from that of the air of the most healthy region. The atmosphere of a crowded city and that of an open or moderately sheltered alpine region, afford by analysis the like number and proportion of ingredients or elements; but notwithstanding this, the influence of the air of these two situations on vegetation is very different. There are certain plants which will not grow in the atmosphere of a crowded city, and there are others which thrive in the former, and will not continue long in that of an alpine air. Some of the following plants grow freely in the atmosphere of the crowded parts of the city of London.

*Plants that grow freely.*
- Sycamore.
- Elms.
- Mulberries
- Ivies
- Virginian Creepers
- Vines
- Oriental Planes, bulbous and tuberous-rooted plants, except Snowdrops.

*Plants that exist for only a few years in perfect health.*
- Laburnum.

*That exist in health only a limited time.*
- Privets
- China Roses
- Alpine Plants, scarcely ever produce flowers.

Since the above list was written, the Bedford Conservatory, or new flower and plant market, Covent Garden, London, has been erected by John Duke of Bedford, and this interesting feature to the ornament of the metropolis will afford extensive means to determine what species of hardy as well as of tender plants will thrive in the atmosphere of so large and crowded a city as that of London. Since this part of the market was completed in the month of June last year, the following plants may be mentioned as having thriven best. The orange, *Citrus aurantium*; camellia, *Camellia Japonica;* rhododendrons, *R. ponticum, R. maximum, R. punctatum.* Some kinds of pelargoniums, *Geranaceæ*, Heaths, particularly *Erica tubiflora, E. cylindrica, E. persoluta, E. cupressina, E. odora-rosa; Acacia verticillata, A. armata, Epachris grandiflora, E. pungens rosea.*

vary from $\frac{1}{60}$ to $\frac{1}{300}$ part of the atmosphere, being greater as the weather is dry and hot, at which time it is most useful to the growth and health of plants, being absorbed by the leaves *. It is clear that water constitutes immeasurably the largest portion of what is taken up by the roots and furnished to the plant by the soil; and when it is considered that water is composed of oxygen and hydrogen, it cannot be supposed to act merely as a vehicle of the food of the tree; it contributes, probably, to the increase of the solid parts of the living structure by decomposition into its elements, through the agency of the vital powers.

Such are the general facts disclosed by chemical examinations of the soil and atmospherical air, with respect to the substances supplied by them to plants as food. An analysis of the sap itself immediately after its absorption by the spongeols of the rootlets, and before it enters the ascending vessels of the alburnum,† would probably leave nothing more to be desired on this important subject, that might apply to the operations of the practical planter. The sap hitherto examined chemically, has been taken from the alburnum of the tree, and consequently after it had undergone a change in its original constitution, or that which characterised it at the moment of its entering the spongeols of the rootlets immediately from the soil. That the sap undergoes a change in the ascending vessels of the alburnum before it is acted upon by the leaves, has been proved by Knight and others. In these instances, the sap extracted from the lower part of the tree, contained much less saccharine matter, than that taken from a more elevated part of the stem. According to Vauquelin, water, extract, mucilage, sugar, and acetic acid, combined with potash or lime, are found in sap taken from the alburnum or ascending sap vessels of the birch, elm, and beech; but these vary in the sap of different species of trees. Saccharine matter is most abundant in the birch and sugar maple. These results, however, afford but little light in the investigation of the question, as we know that the same sap which produces the acid, astringent crab, produces also the saccharine, aromatic pippin. By the action of heat, light, air, and the peculiar organic structure in different species of trees, under the influence of the vital power, are those substances which are soluble in water, or saccharine and mucilaginous fluids converted into insoluble or resinous and oily substances.

* The value of vapour in air to the health of plants, is well known and appreciated by every skilful cultivator of tropical plants in an artificial atmosphere, as well as by the successful forcing fruit and flower gardener in the hothouse. Plants are enabled by vapour in the air to withstand the effects of extreme heat and drought, which otherwise would destroy the organization of the leaves. We ourselves have found the leaves of the province rose, when in an artificial atmosphere, at an early season (and when its vital powers could not be so strongly exerted, as when under the circumstances of its natural season of growth and exposure) to unfold and increase in healthy growth when subjected for a certain time, each day for the space of a fortnight, to hot air strongly charged with vapour, while leaves of the same species did not unfold, or when unfolded previously to the application, shrivelled up and perished under the application of a dry current of air, of the like temperature, and though all other circumstances were equal.

† The rapid communication which exists between the spongeols of the rootlets and the leaves at the extremity of the tree, as evidenced by the sudden effects produced on the latter by the application of water to the roots of a tree whose leaves have become flaccid or drooping from the want of it, warrants the idea that the ascent of fluids from the roots to the leaves is more direct than our knowledge of the structure of the vessels will allow, or that a principle exists in the vegetable structure analogous to that of the irritability of the animal fibre. The well known experiments of Hales to ascertain the force with which the sap of trees ascends, shew that the sap of a vine branch four or five years old rises with a force considerably superior to atmospherical pressure. Plants having the leaves firm and glossy, exhibited proportionally less force in their ascending sap. Vide *Vegetable Statics*, vol. I., p. 114.

From these facts we may conclude that soluble substances, chiefly vegetable extract, mucilage and carbon, with water as a vehicle and a component, presented to the roots of plants under circumstances varying according to the chemical constitution, and mechanical texture of soils, adapted to the peculiar habits or natural wants of different species of trees, as the oak for instance, and the larch, constitute the food of trees supplied by the soil to the roots; and that atmospheric air of a certain temperature, and degree of moisture, and with freedom of circulation, constitutes that other essential part of the nourishment of trees, which is taken up by the leaves or green system of the plant.

Air, like water, requires a certain freedom from stagnation or confinement to render its nourishing and invigorating properties available to the leaves of trees; when comparatively stagnant, its valuable properties become lost to plants. This is indicated by the disappearance of the green colour from the leaves, which soon drop off, and are not reproduced, but the branches die; a few remaining alive at the top of the stem, may continue the existence of the tree for a few years, but without adding to its girth or solidity of contents. These are the invariable effects of stagnant air, the most common and indeed the only cause of which in plantations is the neglect of seasonable *thinning* of the trees, and the removal of dead and decaying vegetable matter as it is produced.

The putrefactive fermentation of spray and brushwood left in close plantations where the circulation of the air is confined, produces fetid gaseous matters, alike hurtful to animal and to vegetable life; the growth of moss on the bark of trees is promoted by it, and whenever this becomes general in a plantation, the progress of the trees is greatly retarded. We cannot better illustrate the importance of attending to this principle of practice in the planter's art, than by stating an instance kindly communicated to us by high authority * on the subject: in many places over an extent of upwards of a thousand acres of the plantations at Blair Adam the prunings of spray and brushwood, and the loppings of the trees thinned out, for which there is no sale in this country, had been allowed to accumulate for many years. The injurious effect was so remarkable, that the proprietor determined to have the accumulation removed. This was done at an expense not very considerable. Ever since the accumulation has been prevented by having a squad of women and boys, to clear away and brush after the woodcutters or pruners. The expense of this operation has been overpaid by the increase of growth, and it is evident that it has added greatly to the value and beauty of the woods, as well as to the growth of underwood †.

To have entered more minutely into the details of the vegetable physiology would have been incompatible with the scope and design of this essay, and to have dwelt less on those principles which bear directly upon every operation of the planter's art, would have rendered the practical details which follow, more obscure and less instructive.

* The Right Hon. Lord Chief Commissioner Adam.

† We have had the gratification lately of examining a considerable part of these plantations, and at the same time of witnessing the triumph of art in rearing valuable timber on situations of great elevation, and in many places more or less elevated, in which wet and undrained land presented difficulties to be encountered and overcome.

## Chapter III.

*Of the different modes of rearing forest-trees:—By sowing the seeds on the spot where they are to remain for timber. By sowing the seeds on nursery beds, and afterwards transplanting the young trees to their timber sites. Modes of propagating and of transplanting, preserving, and training, proper shoots or suckers produced by coppice roots or stools. Comparative advantages and disadvantages of the different modes; and of simple and mixed plantations.*

Before the seeds of forest-trees are sown on the spots where the plants are to remain for the produce of timber, or the young trees are transplanted from nursery beds to their timber sites, the land should be fenced and properly prepared for their reception. As fences, however, are constructed of various materials, turf, or earth, stones, wood, and thorns, or other armed shrubs, and the judicious adoption of the best kind of fence depending on local circumstances, this part of the subject, perhaps, may be more conveniently discussed under a separate head. It has been supposed, with good reason, but certainly without the evidence of such clear and undisputable facts as are absolutely necessary to bring full conviction to practical men, that when forest-trees are reared immediately from seed, and consequently whose tap roots, proper roots, and rootlets have never been disturbed or curtailed, they grow faster, attain to earlier maturity, and produce sounder timber, than such as are transplanted from nurseries. The facts brought forward respecting the structure and growth of trees confirm this opinion; but when useful or profitable planting is the object of the planter, it is necessary to inquire whether these apparent advantages are not lost for the most part, or entirely, in the extra cost or expense which attends the execution of this method, in comparison to that of transplanting; or whether the extra feet of timber, that may be thus gained, will repay with profit the increased cost of production. A detail of the different processes of these two first-mentioned modes of rearing forest-trees may assist materially in coming to a just conclusion on this important question. The oak being one of the most valuable of forest-trees, and its roots penetrating more directly, and to a greater depth in the subsoil than those of any other tree approximating to it in value, it has been thought to suffer great injury by transplanting, and has, therefore, been chiefly insisted upon to be raised immediately from seed on its timber site.

Should the land on which it is intended to rear oak immediately from seed, be not in a clear state of tillage, it must be brought into that state by the most eligible means; these, of course, will depend on the nature of the soil and condition of its surface. If the soil to be sown is clayey and tenacious, retentive of moisture, and covered with coarse plants, as sedges (carix), rushes (juncus), thistles (carduus), and turfy hair-grass (aira cæspitosa), the surface should be pared and burnt, the ashes carefully applied, and the soil ploughed as deep as the nature of the subsoil will permit. It should have a clear out summer fallow, with repetitions of cross ploughings and harrowings, as often as is necessary, to bring the land to a friable and deep tilth. It should be ploughed into ridges twelve feet wide, sufficiently high to give an inclination from the crowns of the ridges on each hand to carry off all surface water, and be well water-furrowed. A dressing should be applied of compost of dung, coal ashes, road scrapings, sand, &c., or any other manure that can be procured, which may have a tendency to divide the texture of the tenacious soil, and make the tilth friable and deep. This part of the process will be found highly useful, and also necessary to insure a well-founded hope

of success. An application of lime, when it can be procured at a reasonable cost, will also be found highly useful.

Should the effects of these operations have been powerful enough to bring the land to the essential condition of cleanness, depth, and fineness of tilth required, the soil will be ready for the reception of the acorns in the spring. Unreclaimed lands, however, of this description can seldom be prepared as above by the out summer's fallow only; and in such cases it will be necessary to continue the process of fallowing for another season. A green crop fallow may be now adopted; and should the weather be favourable, the crop will probably cover the expense of cleaning for that season, or at all events considerably lessen the cost of fallowing. The choice of the crop to be employed must be determined by the condition or adaptation of the soil to certain kinds of green crops, and the greater local demand that may be for one kind of produce more than another. The following may be pointed out: Swedish turnips, rape, potatoes, cabbages, and winter vetches. For these crops it may be unnecessary to add, that the row and ridge system of culture should be adopted, as affording the greatest facilities for cleaning and pulverizing the land, either by the hand or horse-hoe, and thereby obtaining the great objects in view in their most perfect state, and at the least comparative cost. Green crops are here mentioned for fallow, because they exhaust the soil less than corn crops, and also afford the means of destroying every kind of weed much better; but if a corn crop should promise better advantages than a green crop, and secure the cleaning and pulverization of the soil, there can be no possible objection to it, the extra manure given with the corn crop supplying the loss supposed to be caused to the soil. As soon as the crop, of whatever kind, is reaped and carried, advantage should be taken of the first favourable weather to have the surface scarified, horse-hoed, or skim coulter ploughed (according to circumstances of convenience, in the possession of one or other of these implements), and the weeds collected by the harrow, and by the hand if necessary. It is, in this case, the safest mode to burn the weeds, for their seeds and the eggs of insects are thereby more certainly destroyed. The land should now be ploughed up to stand the winter's exposure. The mode of ploughing is of importance at all times, but most particularly so when the full effect of frost and winter weather is required to divide and ameliorate an adhesive clayey soil. When the furrow slice of a soil of this description is reversed, or laid quite flat, the weight and tenacity of the soil consolidate its surface almost immediately, and obstruct the action of the weather in breaking down the texture of the soil, as well as that of the harrows in raising a tilth, or the greatest depth of mould for covering the seeds. But when the furrow slice is raised up so as to lie at about an angle of 45°, the greatest possible surface of the soil that ploughing can accomplish is exposed to the direct influence of the atmosphere in the most effective manner*. As soon as the weather will permit in February, the harrows should be used to raise as deep a tilth as possible; and when this mould is in its driest state, the last ploughing should be given: the reversing of this comparatively dry and ameliorated mould to the bottom of the staple of the soil is of great advantage to the growth of the plants.

* 'Hally's plough' is admirably constructed for this mode of ploughing.

It may be supposed that the preparation of the soil has here been too minutely dwelt upon; but being a part of the subject of considerable importance, in many instances too little attended to, and from the neglect of which failures of considerable extent have had their origin, as regards this mode of rearing oak trees, we have ventured to state thus much on the point.

By the beginning of March favourable weather will have occurred to use the harrows so as to obtain a proper depth of surface mould in which to sow the seeds; but it is essential that the greatest possible depth of mould be obtained, though the time of sowing be delayed until the middle of that month, but which should be avoided if possible.

There are two distinct varieties of the British oak, differing in the quality of the timber and quickness of growth. In collecting the acorns for sowing, therefore, it is of consequence to select those of the most valuable variety. The discriminating characters of these will be pointed out hereafter, when we enumerate all the different species and varieties of forest-trees: here it will be sufficient to mention, that the most valuable variety of the oak is distinguished by having the acorns on footstalks (*Quercus Robur pedunculata*), and the less valuable variety by bearing the acorns without footstalks (*Quercus Robur Sessiliflora*). If it were possible to have the land in a fit state for sowing in autumn, as soon as the acorns were ripe, and the attacks of mice, birds, and insects upon them could be securely guarded against during the winter, the autumn would be doubtless the most favourable season for sowing; but as this can seldom be done, the acorns must be carefully preserved until spring, by spreading them out in a thin layer on a dry, cool floor. When placed in sand, unless the same be perfectly dry, the acorns are apt to vegetate; and the same thing happens when they are placed in heaps, or in too thick a layer.

The land being thus prepared for the reception of the seed, and the acorns ready, drills or furrows should be drawn with the hand-hoe two inches deep, and at intervals of four feet. In order that the rows of plants may not obstruct the surface-water from passing off by the declining sides of the ridges, a point of great importance in this kind of soil; the furrows for the seed should be at right angles to the ridges. The one-horse drill which, under other circumstances, would be the most economical mode of drawing the drills, is inconvenient here, on account of the curve of the ridges and the open drains in the furrows, over which the drill would have to pass*. The acorns should be dropped in the furrows at about two inches apart: this thick sowing is to guard against the numberless casualties which thin them in the course of their vegetation in an exposed field or common, and also to allow the selection of the strongest seedlings to stand for timber—a part of the duty of the planter requiring great attention, and which hitherto has scarcely been attended to, or but incidentally. The acorns should be carefully covered with two inches depth of mould. The back of a large wood-rake will be found to fill up the drills effectually and with dispatch. As soon as the young plants appear above ground, the soil should be hoed, and every appearance of weeds destroyed. Hand hoeing must be repeated as often as weeds appear, or the surface of the ground becomes hardened; in fact the land must be kept in as clean a state, and as free from weeds, as the best managed seedling beds in a nursery garden, or disappointment and failure in a greater or less degree is certain to follow. The surface of a soil of this description, as regards the successful germination of seeds and growth of seedling plants, requires to be kept always in a friable, loose state; for if once it becomes hardened and cracks, the seedling plants will be injured, their leaves assume a pale sickly hue, and their growth will be greatly retarded. Where the plants are suffered to remain long in this state, the sap vessels become contracted in the bark and leaves, and the plants never regain that vigour of constitution which, in this stage of their growth, is so essential to their future perfec-

* These drains are recommended to be made immediately after the ridges are formed, that the land may have the benefit of their free action a twelvemonth at least before the sowing of the seeds.

tion. The stem and branches remain stationary, until the roots, by the influence of a favourable season or two, sometimes force a new stem from the base of the stinted one, which in the course of one year overtops it, and becomes the stem or body of the tree; the original stem, taking the place of a secondary branch, soon disappears altogether. This is the invariable consequence when the growth of the plant, under these circumstances, is left to the unassisted efforts of nature—a fact upon which is founded the practice of cutting down to the surface of the ground stinted young plants, in order to produce superior stems, which always succeeds with the oak, chestnut, and ash, but never with coniferous trees of pine and fir.

During the summer of the second year, the plants which have escaped the attacks of the enemies before alluded to will be strongly marked in the rows, and the horse-hoe may now in consequence be substituted for the hand-hoe: this will be found very beneficial as attaining the great objects of perfect weeding, pulverizing, and rendering friable and porous the surface of the soil at a diminished expense. The rows, however, will require to be looked over and handweeded with care.

Should the plants stand nearer to each other than one foot, they must be thinned out to that distance in the spring of the third year of their growth. In this process it is of the utmost importance that the smaller and least healthy looking plants should be taken out, and those left which indicate the possession of a vigorous constitution, without regard to the mere circumstance of exact distances. When a plant has a robust stem, clear bark, and a plump leading bud, we may consider it as certain to produce a fine tree, or to contend with most success against natural defects of soil and climate, and accidental injuries. To protect young oaks against uncongenial climates, the best method is to plant nurse-trees of quick growth, and well adapted to the soil, amongst them. An artificial climate is thus produced, and to a certain extent, also, the soil is ameliorated by the roots of these nurse-trees running near its surface, while the oak has its roots obtaining nourishment from below; the former, acting as drains, assist the growth of the oak, until its own roots and stem have acquired sufficient strength and dimensions to resist with effect the various unfavourable circumstances above alluded to. In soils suitable to oak this is not always necessary; but deficiencies of soil and climate are generally remedied by the judicious planting of nurse-trees, of which we shall treat more particularly hereafter. The keeping down of the weeds, and the pulverizing of the soil by the hoe, being unweariedly attended to, the young trees will make rapid progress, and will require to be thinned out to four or five feet on an average in the rows, in the fifth year from sowing, when they will have reached that period at which the opposite and more general practice, that of transplanting from seed beds to the timber sites, begins; and as the subsequent culture, pruning and thinning, is the same in both instances, to be treated of separately, we shall proceed to consider the rearing of forest trees by transplanting. No greater error exists in the planter's art than the doctrine that trees should be raised on the same quality of soil as that to which they are to be transplanted,—as if a robust, healthy plant were less likely to withstand its subsequent casualties of situation, soil, and local climate, than a weaker plant with contracted sap vessels—the invariable consequence of a poor seed-bed soil. What is the intention of all the various processes of culture which have been just described as essentially necessary to the raising of oak from the acorn on a damp, cold, clayey soil, but to *enrich* the soil, and render the seedling plants vigorous and healthy? and with how much less labour and expense can this be effected in a nursery bed of clean fresh soil, of whatever nature or texture, than on the extensive site of an intended plantation of forest trees?

Experience fully confirms that principle of vegetable physiology which teaches that robust, healthy plants, whether in the seedling stage of growth or of a larger size, succeed better than those of stinted growth, even when transplanted to the least favourable soil and exposure.*

Where the land to be planted with forest-trees is an extensive tract and remotely situated, and where the seeds of the several kinds can be procured genuine, of good quality, and at a small cost, the formation of a private nursery may be advisable; but where the plants can be procured from a reasonable distance, it will be found the most economical and effective to purchase them from the nurseryman, and even in the former case one or two years' seedlings should be procured in place of seeds, as a saving of time and expense. The following are essential points to be considered in establishing an effective nursery: fencing, shelter, aspect, soil, and management. The fence of a forest-tree nursery requires to be *rabbit-proof*, or loss and disappointment are almost certain to follow. A foundation of brick-work should be made for a superstructure of close paling. Where shelter is not an object, a very cheap and excellent substitute is found in iron wire-netting, which is manufactured for the general purposes of fences to young plants. *Shelter* is indispensable to the free growth of seedling plants, the injurious consequences resulting to which from sudden checks have already been mentioned, as also the bad effects of confined air to the health and prosperity of trees in every stage of growth; and therefore, at the same time that a full protection against cold, bleak winds and unfavourable aspects is necessary, a full and free circulation of atmospheric air must be secured, to allow of a well-grounded hope of success.

The *soil* of the nursery must be of an intermediate quality as to moisture and dryness, not less than eighteen inches deep to the subsoil, and under a south, east, or west exposure, or intermediate points of these. The varieties of soil required for particular kinds of trees will have to be supplied where the natural soil is deficient, as has already been specified when speaking of the seeds of trees. (p. 13.)

*Management.*—This head comprehends an ample degree of practical skill in the superintendent and workmen; the erection of proper sheds, the means of carriage for composts, soils, plants, &c., immediately when needed. A quantity of compost and different soils should always be in readiness when wanted for the seedling beds, layer stools, and cutting beds, and a proper assortment of nursery garden tools, which shall be specified hereafter. The preparation of the soil, the mode of sowing, and the different kinds of forest-tree seeds, have already been described. All kinds of forest trees, however, are not raised from seeds, either because

* It is difficult to give a definition of what is termed a *robust, healthy plant*, so as to apply to every species of tree wherein the habits of growth vary in every individual species. The points of excellence cannot be estimated statically, or by weight and measure, but comparatively. A number of minute discriminating characters, collectively, are readily distinguished by the eye, but when taken separately cannot be usefully described in words. A robust, healthy plant, not exceeding five years' growth, may be said to have equally divided roots, the principal ones of moderate length well furnished with secondary rootlets, and these with numerous fibres; the stem straight, and possessing a girth or diameter proportionate to its length; the bark clean, with an epidermis on the young wood exhibiting fissures, as if bursting or giving way to the increasing size of the parenchyma, particularly in the season of spring or autumn; the buds full in size and not crowded; the leaves perfectly shaped, and of the natural colour. The opposite of this state, from the effects of a poor or ungenial soil, exhibits all these characteristics in a diminished form and number; the opposite extreme or unhealthy state of a plant, from the effects of over-richness of soil, may be supposed; for in our experience we have never met with an instance of the kind, to have all these parts of the structure in an enlarged excess.

they do not perfect a sufficient quantity for the general purposes of propagation, or are accidental varieties only of a species losing their characters of distinction when reproduced from seed. The following modes of propagation are found effectual when seeds cannot be obtained: first by *suckers*, second by *layers*, third by *cuttings*, and fourth by *grafting*.

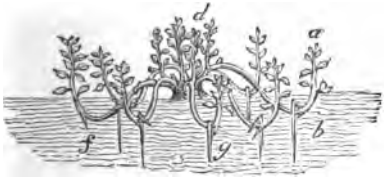
1st. *Suckers* are shoots produced by the creeping roots of a tree, which, when separated from the parent root and transplanted, become perfect trees. They are generally sufficiently rooted in the first season of their production, and they should not be suffered to remain longer than two seasons attached to the root of the tree; for if continued longer, the support they derive from the parent root prevents them from making independent roots of their own in such abundance as they do when separated or taken up at an earlier period. The spring is the most proper season for taking them from the parent roots. When a sufficient number of rootlets appear on the sucker, no part of the root from whence the sucker sprang should be left attached to it; but where the proper rootlets are deficient in number, a small portion of the parent root may be left with advantage. The plants should be planted in rows in fresh soil, and treated in all respects afterwards as directed for seedling transplanted trees. The kinds of trees chiefly reared in this mode are:

The abele tree, *Populus alba.*
Common white poplar, *Populus canescens.*
Aspen, *Populus tremula.*
Chinese ailanthus, *Ailanthus glandulosa.*

The first three kinds may also be propagated by layers.

2nd. *Layers.*—The process of *layering* is well known: it consists in bending a young branch (*a*, *fig.* 2) into the soil to a certain depth, and elevating the top part of it out of the soil in an upright direction; in time the buried part takes root, and the shoot becomes a perfect plant. The root which produces the young shoots for layering is called the stool. Stools are planted about six feet apart every way in a deep fresh soil. The stem at first is either bent down into the ground as a layer, or cut over a few inches from the root. The shoots which are produced from its sides form the layers (*d*). The rooting of the layers is much facilitated by obstructing in part the descending sap; this is essential to some kinds of layers, though not to all: the common laurel, privet, &c., strike root readily without any artificial stoppage of the descending sap. The most expeditious mode of effecting this, is to cut a notch, slanting upwards to the origin of the layer, about half a diameter in length (*f*), and securing the position of the layer in the ground by a wooden peg (*g*). Where the shoot is of a nature that roots with difficulty, it is useful to split the *tongue* of the notch half way up, and to insert a small wedge of potsherd or wood to keep the division open. Rings of wire are also sometimes used for the same purpose, and cutting the bark round the part to within a little of the complete circumference of the shoot. In all ordinary cases, however, the slit or notching mode is perfectly effective. The ground should be kept quite clean of weeds, and watered in dry weather. When sufficiently rooted, the layers should be carefully cut away from the shoots, with all the fibrous roots attached to them, and planted in rows in fresh, well-prepared soil. The stools should have all the stumps of the branches cut away, and left to produce a fresh

*fig.* 2.



series of shoots for next autumn's layering. The following trees are propagated by layers.

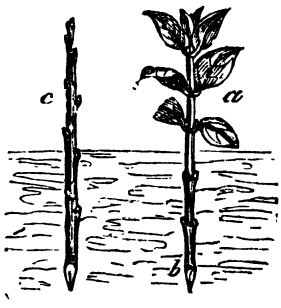
Maple, silver striped maple, *Acer campestre, fol. arg.*
Sir G. Wager's, *A. dasycarpum.*
bastard, *A. hybridum.*
lobe leaved, *A. lobatum.*
mountain, *A. montanum.*
ash leaved, *A. negundo.*
Italian, *A. opalus.*
striped barked, *A. Pennsylvanicum.*
cut leaved, *A. platanoides laciniatum.*
gold striped, *A. pseudoplatanus, fol. aur.*
silver striped, *A. pseudoplat. fol. arg.*
Tartarian, *A. Tartaricum.*
Montpellier, *A. monspessulanum.*
Alder, cut leaved, *Alnus laciniata.*
oak leaved, *Al. quercifolia.*
prickly leaved, *Al. glutinosa spinulosa.*
Turkey, *Al. oblongata.*
oval leaved, *Al. oblong. elliptica.*
Birch, daurian, *Betula daurica.*
Canada, *B. lenta.*
black, *B. nigra.*
paper, *B. papyracea*
poplar leaved, *B. populifolia.*
red, *B. rubra.*
Hornbeam, cut leaved, *Carpinus bet. incisa.*
Judas tree, American white flowered, *Cercis silig. fl. alba.*
Date plum tree, *Diospyrus lotus.*
Spindle tree.
gold blotched, *Euonymus Europ. fol. aur.*
silver, *fol. arg.*
white, *fruc. alb.*
pale, *fruc. pal.**
Beech, broad leaved, *Fagus ferruginea.*
purple leaved, *F. sylvatica purpurea.*
copper leaved, *F. sylvatica cuprea.*†
Ash, weeping *Fraxinus pendula.*‡
curled leaved ash, *F. atra*
flowering ash, *F. ornus.*
manna ash, *F. rotundifolia.*
striped barked ash, *F. striata.*
Mulberry, white, *Morus alba.*
common, *M. nigra.*
Tufelo tree, *Nyssa aquatica.*
mountain, *N. montana.*
Bird cherry, *Prunus padus.*
Cornish, *P. pad. rubra.*
Buckthorn, sea, *Rhamnus catharticus.*
Lime tree, white, *Tilia alba.*
broad leaved, *T. Americana.*

* These four trees are of low growth, and only for ornament
† Propagated also by grafting.
‡ When grafted on the common or tall ash, the pendulous branches have a striking effect.

common, *T. Europæa.*
red twigged, *T. Europ. corallina.*
downy leaved, *T. pubescens.*
Elm, English, *U. campestris.*
striped leaved, *U. fol. var.*
Cornish, *U. sativa.*
hornbeam, leaved *U. nemoralis.*
Dutch, *U. suberosa.*

3rd. *Cuttings.*—Shoots of one year's growth are the most proper to be used in this mode of propagating several kinds of forest trees. The shoots should be selected from the most healthy and free-grown branches, and cut into lengths of from six to eighteen inches, according to the kind of tree. If evergreens (*a*, fig. 3), the leaves should be cut off half way up from the root-end of the cutting (*b*). Deciduous trees should have shed their leaves before the cuttings (*c*) are taken from them. The root-ends of the cuttings should be cut finely smooth, and inserted from about a half to three parts of their length into the soil. For every species of cutting, the soil should be light, and composed, at least, of half of fine siliceous sand. There are many species of exotic plants, whose cuttings will only strike root in pure siliceous sand. It need hardly be remarked, that in this mode of propagating, watering is more particularly required to be attended to than in any other. The utility of the sandy nature of the soil consists in its retaining no stagnant moisture, but just sufficient for the wants of the shoot during the process of rooting. As soon as the cuttings are well rooted, if in a light soil of the above description, they should be carefully taken up and transplanted to their proper soil; for although the shoots produce roots more quickly and in greater abundance in the siliceous sandy soil, yet it is unable to support the growth of the plant after the proper functions of the roots begin. Next to that of propagation by seeds, plants may be increased by cuttings more generally than by any other mode: the process, however, requires more time, skill, and attention, than is demanded for rearing trees from suckers, or by layers or grafting, and it is therefore chiefly practised for the increase of exotic ornamental plants; but the following forest trees are most advantageously raised from cuttings:

*Fig.* 3.

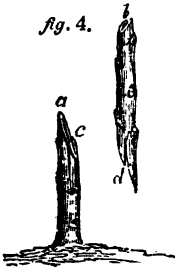



Plane, American, *Platanus occidentalis.*
Spanish var., *P. acerifolia.*
Oriental, *P. orientalis.*
waved leaved, *P. cuneata.*
Poplar, Carolina, *Populus Carolina*
Lombardy, *P. dilatata.*
Athenian, *P. Græca.*
Canadian, *P. monolifera.*
black, *P. nigra.*
weeping, *P. pendula.*
trembling, *P. tremula.*
Maiden-hair tree, *Salisburia adiantifolia.*
Willow tree, common, *Salix alba.*
Peach leaved, *Amygdalina.*

Duke of Bedford's, *Russelliana.*
weeping, *Babylonica.*
round leaved, *Capera.*
gray, *Cineria.*
crack, *Fragilis.*
spear leaved, *Hastata.*
common, *Helix.*
fine stemmed or smooth leaved, *pentandria.*
triandrous, *triandra.*
golden osier, *vitellina**.

4th. *Grafting*, in forest-tree propagation, is chiefly had recourse to for those varieties of trees which lose their distinctive characters when reproduced from seed, and which make finer trees when grafted on free growing stocks of their own species. The scions† take more freely when not more than of one year's growth, but those of much older growth will succeed. The most perfect grafting is where the scion and the part of the stock to which it is to be united are nearly of an equal size, for on the perfect contact of the inner bark of the scion and stock depend the perfect union of the two in the shortest space of time, and consequent equal healing of the wound. The month of March is the best season for forest-tree grafting. The modes of grafting are numerous. French authors enumerate upwards of forty; for the purposes now under consideration, however, that termed *whip* or *tongue* grafting is generally followed. The scions should be selected from the more upright, free-growing branches; the middle portion of the shoot is the best; but where there is a scarcity of grafts, the top and bottom may be used, as these will succeed, though not likely to produce such fine trees. From two to five buds should be left for the production of a leading stem and branches. The stock should be cut in an oblique direction (*a*, fig. 4), and the scion in like manner at a corresponding angle *(b)*; a slit should then be made in the stock about the middle of the wound, passing downwards (*c*), and a similar slit upwards in the scion (*d*); the upper division of the scion made by the slit, termed the *tongue* or *wedge*, is then inserted into the cleft of the stock, and the inner barks of the stock and scion brought into perfect contact, at least on one side. This should be effected with as little delay as possible. The parts are then to be bound with a riband of bass, and particular care should be taken that, in this part of the process, the junction of the two barks is not in the least displaced. To protect the grafted parts from drought and moisture, and from the action of the air, various means have been adopted, but the most direct and useful is well-worked clay, cleaned of gravel or small stones, and horse-droppings, well incorporated and mixed in the proportions of three parts of the former to one of the latter; a little finely-chopped straw is added with advantage. The clay should be

*fig.* 4.




* This numerous and highly interesting tribe of forest plants, from the useful and varied properties which the different species evidently possess, demand more of the notice of the forest planter than they have yet received. The extensive and important trials instituted by John Duke of Bedford, now in progress, to investigate the comparative merit of all the different species of willows, will afford much useful information on the subject.

† Scions may be separated from the parent stock some time before grafting, without suffering injury from being kept, but the root-ends should be placed in earth to prevent the bark from shrivelling. The ascent of the sap in the stock being more advanced in the stock than in the graft, is sometimes advantageous.

placed on the grafted parts an inch thick on every side, and extend about half an inch above and below the union of the stock with the graft*.

*fig.* 5.

Another mode, called *saddle grafting*, is perhaps better adapted for forest trees than the foregoing, but it takes up more time in the performance. The stock should be cut so as to leave the top in the form of a wedge (*a*, *fig.* 5); the scion split at the lower end, and each side of the incision pared obliquely, so as to form the two divisions into tongue-like processes (*b*); these are then seated on the wedge and made to fit accurately to each side of it. The after operations of tying and claying are the same as in the former mode. The trees which come under the forester's care that require to be reared by grafting are the following:

Broad-leaved evergreen oak, *Quercus ilex latifolia.*
- entire leaved, *Q. ilex integrifolia.*
- Lucomb's, *Q. Exoniensis.*
- Turner's, *Q. Exoniensis Turneri.*
- broad-leaved Lucomb's, *Q. Exoniensis latifolius.*

Sweet crab tree, *Pyrus coronaria.*
- Siberian crab, *P. prunifolia.*
- willow leaved, *P. salicifolia.*
- Chinese, *P. spectabilis.*
- wild service, *P. terminalis.*
- white beam, *P. aria.*
- Swedish white beam, *P. aria dentata.*
- small fruited crab, *P. baccata.*

Heart-leaved poplar, *Populus candicans.*
- various leaved, *P. heterophylla.*
- smooth leaved, *P. heter. lævigata.*

Upright medlar, *Mespilus germanica.*
- weeping medlar, *M. ger. diffusa.*

Entire leaved ash, *Fraxinus simplicifolia.*
- striped barked, *F. striata.*
- variegated, *F. variegata.*
- white American, *F. Americanus.*
- black, *F. Amer. pubescens.*
- red, *F. Amer. rubrus.*

Gold striped beech, *Fagus sylvatica fol. aur.*
- silver striped, *F. sylv. fol. arg.*
- copper coloured, *F. sylv. cuprea.*
- purple leaved, *F. sylv. purpurea.*

Gold striped Spanish chestnut, *Castanea vesca, fol. aur.*
- silver, *C. ves. fol. arg.*
- various leaved, *C. ves. heterophylla.*
- shining leaved, *C. ves. lucida.*

Gold striped horse chestnut, *Æsculus hippocastanum, fol. aur.*
- silver, *Æ. hipp. fol. arg.*
- yellow horsechestnut, *Æ. flava.*
- scarlet, *Æ. paria.*

* It is a highly useful practice to draw earth up round the clay so as to cover it entirely from the sun and air.

The stocks for these trees should be raised from seed of the common species, to which each variety is nearest allied, for the nearer the connection of the stock with the graft the more lasting is the union and more perfect the growth. In trees that have been grafted on unsuitable stocks, we frequently see the base of the stem abruptly contracted to a smaller circumference than the upper portion, and *vice versâ*, just as the stock or the graft happens to possess the freest habit of growth. The stocks should be planted in rows two feet apart, and should be one foot distant plant from plant. When arrived at two years of transplanted growth they will be in a fit state to graft. The grafts should be united to the stock as near to the root as convenient. This facilitates the vigorous growth of the tree, and allows of the earth being drawn up on each side to cover the *clayed* portion of the graft. The clay should be removed from the grafts, and the ties or bandages loosened when the progress of the new shoots of the graft indicates the perfect completion of the process. In the spring following that in which the trees were grafted, many of them may be transplanted to their permanent sites; but it is better, as a general rule, to defer transplanting until the second autumn or spring. The *size* of the different kinds of trees most suitable for final transplanting is a point of some importance, particularly when the planting is on a large scale, and where the preservation of every fibre of the roots of the plants cannot be accomplished without an unnecessary expense of time and labour. A very young plant may be readily taken up and transplanted with its roots entire; but a plant of several feet in height requires considerable care in taking it up to preserve its roots from injury. The structure and the functions of the roots of trees, as connected with the produce and support of the plant were before described, and clearly point out the essential use of the minute rootlets and their accompanying spongeols or glands to the nourishment of the plant in every stage of its growth, and under every change of circumstance. Accordingly we find that, if a plant is taken up and transplanted with all its roots entire and uninjured, it experiences scarcely any perceptible check, unless its roots are exposed to the effects of the sun and wind for any considerable time, in which case it makes little, if any progress for a season. A moderate degree of pruning, however, of the overgrown and straggling roots of young trees, possessing the reproductive power in a full degree, and of the branches of their stems, is often expedient, and, when judiciously performed, is beneficial: it prevents the accident of doubling up the roots, or improperly disposing them in the soil, an evil of worse consequences to the plant than the shortening of an overgrown root, or lateral branch. To trees which possess the reproductive power in a very imperfect degree, pruning the roots or branches preparatory to transplanting is injurious. The facility with which young plants of any kind can be taken up without hurting the roots, and the slight pruning which they require at that stage of growth, point out as a general rule in deciding on the most proper size of the different species of trees for final transplanting, that the non-reproductive kinds should be of the smallest size or earliest stage of growth, and those in which the reproductive power is greatest of the largest size. If we divide the stem of a Scotch fir, or a larch, a corresponding stem is not reproduced; but if we cut down, in like manner, a willow, or even a chestnut, or an oak, a vigorous stem will follow. Where the habit of the roots is to divide into large branches, and run deep into the ground, as in the case of the oak, younger plants are required for transplanting than in those instances where the habit of the root is to produce numerous fibres. The nature of the soil also dictates, in some measure, the size of

the plants. In rocky, elevated soils that cannot be ploughed or trenched, nor can allow of proper sized holes being made with the spade, plants of one or two years growth, or such as have small roots, can only be planted: when exposed to severe winds, plants above one foot in height are loosened in the soil, and never prosper. For the purposes of general or extensive works of forest planting, the best sizes of the plants of the different species of trees at the period of transplanting to their timber sites, may be thus enumerated:

1st. NON-REPRODUCTIVE OR RESINOUS TREES.

| | | Height | |
|---|---|---|---|
| Pinus | *abies*, common spruce fir, from | 6 to | 20 inches. |
| | *alba*, white spruce. | | |
| | *rubra*, red spruce. | | |
| | *nigra*, black spruce. | | |
| | *sylvestris*, Scotch fir. | | |
| | *laricis*, Corsican fir | | 24 |
| | *uncinata*, hooked fir | | 18 |
| | *pumila*, upright coned fir | | 12 |
| | *Mughus*, nodding coned fir. | | |
| | *pungens*, prickly coned fir. | | |
| | *Banksiana*, Hudson's Bay fir, in pots* | | 24 |
| | *Pallasiana*, Prof. Pallas's fir. | | |
| | *pinaster*, cluster fir | 6 | 20 |
| | *pinea*, stone pine | 6 | 18 |
| | *maritima*, sea-side pine | 6 | 18 |
| | *Halepensis*, Aleppo pine | 6 | 18 |
| | *inops*, Jersey pine | 6 | 18 |
| | *resinosa*, pitch pine | 6 | 18 |
| | *variabilis*, various leaved pine. | | |
| | *Clanbrassiliana*, dwarf pine. | | |
| | *tæda*, frankincense pine, in pots. | | |
| | *serotina*, fox-tail pine. | | |
| | *rigida*, three-leaved pine | 6 | 20 |
| | *palustris*, swamp pine, in pots. | | |
| | *longifolia*, long leaved pine. | | |
| | *Cembra*, Siberian pine | 6 | 18 |
| | *strobus*, Weymouth | 12 | 36 |
| | *excelsa*, Bhotan, in pots. | | |
| | *cedrus*, Cedar of Lebanon, in pots. | | |
| | *deodara*, Indian cedar. | | |
| | *pendula*, black larch. | 6 | 24 |
| | *microcorpa*, red larch. | | |
| | *larix*, common larch. | | |
| | *Canadensis*, hemlock spruce | 9 | 20 |
| | *dumosa*, bushy pine, in pots. | | |
| | *taxifolia*, yew leaved, in pots. | | |
| | *picea*, silver fir | 9 | 20 |
| | *spectabilis*, purple coned, in pots. | | |
| | *balsamea*, balm of Gilead | 9 | 20 |
| | *Fraseri*, double balsam, in pots. | | |
| | *adunca*, crooked. | | |
| | *Romana*, Roman. | | |

* By this is meant such sorts of forest-trees as from their rarity, or recent introduction of very small quantities of their seeds, have rendered the utmost care and caution necessary in the first attempt to cultivate them here; by and by, instead of being raised in pots, the seeds may be found to succeed equally well in the open ground.

| | | Height. |
|---|---|---|
| Pinus | *Siberica*, Siberian pine | 9 to 20 inches. |
| | *pickta*, pigmy pine, in pots. | |
| | *orientalis*, oriental pine. | |
| | *Lambertiana*, Lambert's pine, in pots. | |
| | *ponderosa*, heavy wooded. | |
| Araucaria | *imbricata*, Chili pine. | |
| Taxodium | *distichum*, deciduous cypress. | |
| Cupressus | *sempervirens*, upright evergreen cypress. | |
| | *thyoides*, white cedar. | |
| Juniperus | *Virginiana*, red cedar. | |
| Thuja | *occidentalis*, American arbor-vitæ. | |
| | *orientalis*, Chinese. | |
| | *plicata*, Nee's. | |
| | *Caroliniana*, Lucas's arbor-vitæ. | |

2d. Reproductive trees.

| | | Height. | |
|---|---|---|---|
| Quercus, oak, different species of | from | 6 to | 30 inches. |
| Fraxinus, ash, different species of | | 6 | 20 |
| Castana, Spanish chestnut | | 12 | 30 |
| Æsculus, horse chestnut | | 12 | 30 |
| Fagus, beech | | 6 | 20 |
| Betula, birch | | 9 | 30 |
| Alnus, alder | | 6 | 24 |
| Carpinus, hornbeam | | 6 | 24 |
| Platanus, plane | | 12 | 30 |
| Acer, sycamore | | 6 | 30 |
| Maple common | | 6 | 24 |
| Norway | | 6 | 24 |
| Grafted and layer reared species | | 12 | 36 |
| Tilia, lime, common, and others | | 12 | 36 |
| Ulmus, elm, wych | | 9 | 30 |
| Grafted and layer reared species | | 18 | 36 |
| Populus, poplar, different species of | | 18 | 36 |
| Salix, willow tree, species of. | | | |

Those species which are mentioned as raised in pots for transplanting, except the cedars and a few others, are as yet considered merely ornamental trees, the period of their introduction not having allowed sufficient time to prove their properties or comparative value as timber trees. It is highly desirable to plant them, with a view to ascertain that point, several of them being highly valuable in their native countries. The pinus Lambertiana has been found to have attained to the growth of 200 feet in height, and 57 feet in circumference*.

*Modes* of transplanting. Much difference of opinion prevails on the comparative merits of the different methods of planting from time to time introduced, and more or less practised. Trenching is held by some to be essential to success, without considering that there are situations and soils where timber of the most valuable quality may be produced that cannot be dug or trenched. Others again infer, that to insert seedling plants into the soil in its natural state is all that is required for the production of timber and underwood possessing every requisite value.

These opinions are too exclusive; they have led to baneful effects, and still are the cause why many extensive tracts of land lie waste, which otherwise might have been covered with profitable plantations. But in more

* Transactions of the Linnean Society of London, vol. xv. Part II. p. 498.

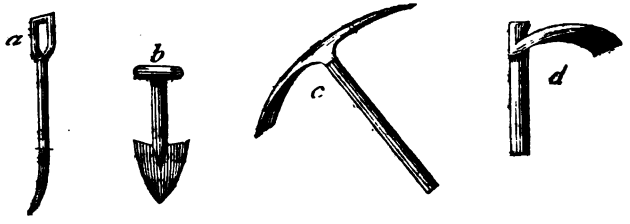
numerous instances, from the same cause, great and unnecessary expenses have been incurred, only to result in a total failure of the plantation, with the consequent loss of time and property. Instances illustrative of these points have been too frequent in the management of the forest lands of the Crown, (which ought to shew an example of practical planting worthy of imitation by the community,) as well as on private estates, to require to be cited here. Well regulated economy in the expense, or first outlay, is one of the principles of the art important to be attended to in practice. Accordingly it is not surprising to find some modes of planting invented, and others misapplied, under the mistaken impression of furthering this principle, at the serious risk of retarding the healthy growth and prosperity of the trees, and of producing results completely subversive of the intention.

The great object of transplanting trees from seed-beds, layer-stools, cutting grounds, &c. to nursery rows, or beds previous to their final transplantation for good, is to increase the number of fibres and rootlets; and, by ensuring the free uninterrupted formation of healthy stems and buds, to lay the foundation of a vigorous constitution in each individual plant before it be finally transplanted to its timber site.

The different modes of planting trees on their timber sites are denominated, first, slit-planting; second, holing or pitting; third, trench-planting; fourth, furrow-planting. There are also varieties of these characterised by the instruments or tools used for inserting the roots of the plants into the soil.

*Slit* planting is the most simple mode, and is practised on soils in their natural state without, any preparation of holing, ploughing, or trenching. It is performed by three different kinds of instruments: viz. by the *moor planter* (*fig.* 6. *a*), by the diamond dibble (*b*), and by the common garden spade.

*Fig.* 6.




1st. The *moor planter* (*a*) is a heavy instrument, consisting of a wooden shaft and handle two feet nine inches in length, terminated by a single slightly curved prong of well tempered iron or steel fifteen inches in length, two and a half inches broad at the insertion of the shaft, and gradually tapering to the point. The handle is made sufficiently large to be grasped by both hands, and the operator with one stroke drives the prong into the ground to the depth required for seedling trees, and by depressing the handle, the point of the instrument raises up the earth, leaving a vacuity or opening in loose earth, into which a person, holding a plant in readiness, places the root, and with the foot fixes it in the soil. A stout active workman with this instrument, and the aid of a boy, will transplant a greater number of seedling trees on light moor soils than by any other method at present known.

2d. The *diamond dibble* (*b*) is recommended by Sang*: it is made of a

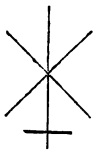
* Planter's Kalendar, p. 170.

triangular shaped plate of steel, furnished with an iron shaft and wooden handle. The sides are each four inches long, and the upper part or side four inches and a half broad. It is used for planting on sandy and gravelly soils where the surface produce of herbage is short. In this case the planter makes the ground ready with the instrument in one hand, and inserts the plant with the other. He carries the plants in a bag or basket suspended from his waist; he strikes the dibble into the ground in a slanting direction so as to direct the point inwards, and, by drawing the handle towards himself, an opening is made, and kept open by the steel plate for the reception of the roots of the plant by the other hand. The instrument is then removed, and the earth made firm about the roots of the plant by a stroke with the heel of the instrument.

3d. By the *spade*, a cut is made in the turf with the spade and crossed by another at a right angle: the two cuts thus made resemble the figure of the letter T. The handle of the spade being depressed backwards forces open the edges of the cuts, and in the opening thus made the roots of the plant are inserted; the spade is then withdrawn, and the turf replaced by pressure with the foot.

Sir John Sinclair describes an improved mode of slit-planting, as follows: The operator with his spade makes three cuts, twelve or fifteen inches long, crossing each other in the centre, at an angle of sixty degrees, the whole having the form of a star. He inserts his spade across one of the rays (*a*), a few inches from the centre, and on the side next himself; then bending the handle towards himself and almost to the ground, the earth opening in fissures from the centre in the direction of the cuts that had been made, he, at the same instant, inserts his plant at the point where the spade intersected the ray (*a*), pushing it forward to the centre, and assisting the roots in rambling through the fissures. He then lets down the earth by removing his spade, having compressed it into a compact state with his heel; the operation is finished by adding a little earth with the grass side down, completely covering the fissures, for the purpose of retaining the moisture at the root, and likewise as a top dressing, which greatly encourages the plant to push fresh roots between the swards*.

Fig. 7.



*a*

4th. The defects of the slit mode of planting are, that the earth is not properly reduced in its texture to suit the tender fibres of the roots of seedling plants, and the natural plants of the surface are left to contend with them for the nourishment afforded by the soil, nor can the rootlets of the young trees be disposed and placed in their right positions. The least objectionable practice is to cut a circular piece of the turf, a foot in diameter, and lay it on one side with the surface downwards; the workman then with his spade loosens and breaks down the texture of the uncovered soil, and, by making ample space for the extension of the roots of his plant in every direction, inserts it in the pulverized earth. The turf which had been reversed and laid on one side, is then with a stroke of the spade divided into two equal parts, and replaced on each side of the plant in its reversed position. The reversed turf supports the plant against the effects of the wind, retains the proper moisture of the soil, and prevents the evil consequences resulting to the lateral branches of the young tree, and to the healthy progress of the stem, from the uncontrolled growth of the herbage natural to the soil,—all of which, by the former modes, are rather encouraged than checked. In uninclosed commons or moors, the natural

* General Report of Scotland, vol. ii. p. 283.

herbage and shrubby plants are kept under by cattle, &c.; but when such lands are inclosed for planting, and thereby protected from stock, the natural plants, which before appeared diminutive and slow of growth, suddenly attain a size and vigorous vegetation highly detrimental to the young forest trees.

2. *Mattock* planting is confined chiefly to rocky ground, and to soils containing many coarse, tough roots of herbage, heath, &c.; and under these circumstances the mattock is an indispensable instrument. It is thus described in the Planter's Kalendar:—'The handle is three feet six inches long; the mouth is five inches broad, and is made sharp; the length of it to the eye or shaft is sixteen inches, the small end or pick is seventeen inches long' (*c*, fig. 6). It may be unnecessary to mention that the broad or hoe end should be faced with steel and kept well sharpened; it is perfectly effective in cutting or paring the heath, furze, &c., and the pick end is equally so for thoroughly loosening and fitting the soil to be operated upon with the spade or *planter* (*d*). The *Hackle* prongs are recommended for clayey, tenacious soils*, which are difficult to work with the spade. It is made with two or three prongs; the former of two for the soil just mentioned, and the latter of three prongs for stony or gravelly soils.

3. *Holing.*—Holes or pits are dug out, and the loosened soil left for a season to the action of the weather, to ameliorate and reduce its texture. Time should be afforded for the rotting or decomposition of the turf or surface produce taken off the space which is opened, previous to the period of planting. The size of the holes should vary according to the size of the plants to be planted, and to the nature of the subsoil. Plants from one and a half to two feet high should have the holes two feet wide and eighteen inches deep, prepared in the summer or autumn for the reception of the plants in spring. For trees of larger growth, the extent of the roots must determine the size of the holes, making an allowance of from six inches to a foot of extra width beyond the extreme points of the roots. Holes made in tenacious clays retain the water which falls into them, and rots the roots of the trees; dry, light, sandy soils cannot be benefited by the pulverizing action of the sun and air; rocky soils admit but imperfectly of holing; and some kinds of binding gravelly soils are as liable to the retention of moisture as stiff clays. The practice of holing is therefore never attended with success on these kinds of soil.

*Spade* planting applies to land prepared for the reception of the plants by trenching. Although this mode of planting is the most common in use, and may appear to require but little exercise of skill on the part of the operator, it is nevertheless often very badly executed. It is best performed when the holes are made a few inches wider than the roots of the plant extend; the earth of the bottom of the hole should be broken down with the spade, the sides all round should be made to slope inwards, so as to cause the bottom to be wider than the top. The person who holds the plant should then place it in the centre of the pit, and the operator with the spade should have ready some fine surface soil to cover the bottom and raise it up to the proper height, the person holding the plant raising it at the same time, so that it may stand not deeper in the soil than it previously stood. The earth should then be carefully thrown in a finely divided state, and the plant during the operation slightly moved, so as to prevent the roots from being covered in bundles, and to afford each root and rootlet to have a portion of soil intervening between it and the rest.

* Pontey's Profitable Planter.

Treading should be avoided, as it renders the soil cohesive, which in stiff or heavy land is an evil of great magnitude to newly-planted roots. In light soils, however, a slight pressure with the foot to keep the plant steady in its place is necessary, particularly if the weather is dry during the season of planting; but in cases where it is practicable, it is much more beneficial to *settle* the earth about the roots of the plants by a free application of water in the usual manner.

It is the best and most expeditious practice to have one set of men to make the holes, and another to finish the planting. When different species of trees are to be mixed in the plantation, and in unequal proportions, each species is successively distributed and planted. What we have already stated respecting the great importance to the success of the plants of not suffering the roots to be dried by exposure to the sun or wind, may render it unnecessary to urge here, that the distribution of the plants on the ground should not be farther in advance than just to keep the planters fully employed. Before laying the plants out on the spots where they are to be planted, it is a most useful practice to dip the roots in water, or in a puddle made of water and rich mould. In planting on a confined scale, the plants may be distributed as before, and two workmen may proceed to open the pits on the spots. As soon as the hole is opened, one of the operators places the roots of the plant in the hole, while the other with his spade finishes the process as above directed. By this method the holes can be made proportionate to the size of the roots of the different plants, which, when of various species, are oftentimes also of different sizes. When circumstances warrant the previous preparation of the soil necessary to this mode of planting, it should be adopted, as being the most perfect and effective.

*Furrow* planting is performed by opening a furrow with the trenching plough, or with two common ploughs; the one succeeding the other in the same trench or furrow, and opening it to the depth required by the roots of the trees. The roots being placed in the furrow at the proper distances, the workman with the spade finds no difficulty in obtaining the necessary quantity of pulverized soil to complete the work. This mode of planting has been practised with success on the Duke of Bedford's estates in Bedfordshire, and in Buckinghamshire in the neighbourhood of Woburn. The implement employed was a very strong plough, drawn by six horses, and opening a furrow from twelve to sixteen inches deep, turning the sward or heath over on each side. This was followed by a scuffler or grubber of three tines, which completely stirred and pulverized the soil. On light land eight acres a day was done in this way, but the soil must be light and free from large stones or other obstructions.

That extensive and valuable plantations have been made by *slit* planting there are abundant proofs, and on elevated, thin, light soils incumbent on rock, or where trenching cannot be effected or the furrow plough be used, this mode may be adopted with economy and success. Before planting by this method, however, it is essential to know the precise nature of the subsoil, and that there does not exist a hardened stratum, impervious to water, beneath the surface, which frequently happens in heaths, or siliceous sandy moor lands, it generally consists of the heath-soil in a compact layer about an inch thick, containing a large proportion of oxide of iron, and impervious to water. Beneath, and next to this, is generally grey or white sand, surcharged with water; and whenever trees are planted, by the slit mode, on soils so constituted, they never make any healthy growth, but perish so soon as the roots reach the hardened stratum: trenching, or the furrow plough must be employed in such cases to destroy the impervious

stratum, and render free the circulation of water and air, otherwise the attempt to establish trees will be vain. When the land is clean, friable, moderately deep, free from, and not retentive of stagnant moisture, the mode of planting by holing may be adopted with propriety. Lands of a tenacious, clayey nature, and also those of the best quality, employed for forest planting, ought to be trenched, as being the most economical ultimately, and the most effectual, for these kinds of soil. The preparation of tenacious clayey soils by paring, and burning, and trenching, has already been stated.

Since the above was prepared for the press, we have perused the able tracts * on planting by W. Withers, Esq., of Holt, in Norfolk. This gentleman, besides shewing, by facts not to be doubted, the superior advantages of trenching, compared to that of holing or slit planting, in the more speedy returns of profits from thinnings, and extra annual increase of timber in the trees left for that purpose, has likewise proved the value of manure to *poor* soils in conjunction with this mode of preparation. That such a mode of preparation with the application of manure should be highly advantageous for the growth of the more valuable timber trees on soils of the nature now alluded to, will be instantly seen by every one who has examined carefully the natural habits of these trees by the principles of vegetable physiology already discussed; and such as may feel reluctant, or have not leisure, to employ this mode of arriving at a perfect conviction, may be amply convinced by comparing that soil on which the oak, for instance, or any other of the more valuable timber trees, invariably attains the highest perfection, with that on which it or they are always inferior. Compare the constitution of the soil No. 2, at page 7, with that of the soil No. 5, and the almost total absence of clay, chalk, and vegetable matter, will be evident in the former. Now, on this soil the oak, according to our experience and observation, is never found in a natural state, and, when planted in it, never attains to any value as a timber tree even with the aid, as nurses, of the pine, birch, and sycamore, which here succeed. On the soil No. 5, where the constituents of the soil are different from those of No. 2, the oak attains to the highest perfection. To supply manure, therefore, composed of clay (burnt or recent), chalk, and vegetable matter, or rotten dung, in the requisite proportions, and by deep trenching (remedying, in some measure, the defects of the subsoil), and by combining and comminuting the whole as intimately as possible, the soil No. 2 would approximate to that of No. 5, and the oak might then be planted with a certainty of its successful produce of timber. Any smaller application than the requisite quantities of these ingredients will, of course, give a diminished result as to the crop of timber, but still it will give an increase in proportion to the quantity applied.

The principle on which manure is objected to for the rearing of forest-trees, is, that it will force the growth of the tree beyond its natural state, and render the deposit of vegetable fibre soft, and of diminished strength and durability. This, however, is carrying the point to an extreme to which it is never likely to be in the power of any planter to arrive, were he even willing to attempt it. To manure a poor soil, for it should be here kept in view that this and not a rich, or even moderately rich soil, is intended, can have but one effect, and that is to improve the growth of the trees. But the great, immediate, and important object of manure here, is to furnish a liberal supply of food while the plant is in its first stages of growth, thereby giving it the means to form a strong constitution, enlarg-

* 'A Memoir on the Rearing, &c., of Forest-trees.' 'A Letter to Sir Walter Scott, Bart., &c.' 'A Letter to Sir H. Steuart, Bart., &c.' By W. Withers, of Holt, Norfolk.

ing its number of roots and rootlets, and, at the same time, improving the quality of the exhalations from the soil, for absorption by the leaves, which is, in fact, an amelioration of the local climate or air. All these important points to the health of the tree, to the value of its timber, and to the attainment of the object in view, a valuable return in the shortest space of time for the capital expended, are thus highly promoted, and, in a great measure, secured by trenching, manuring, and keeping clean of weeds or surface culture for a limited period after planting. As an answer to the important question, will the sum expended in trenching and manuring be returned with interest and profit in proportion to those of the lesser sum required for planting on unprepared land, Mr. Withers has brought forward facts and observations to which we shall revert when discussing the subject of the valuation of timber trees.

The proper distances at which young forest trees should be planted on their timber sites depends on the natural habits of growth of the different species, the nature and preparation of the soil, and the size of the plants to be planted.

The larch, spruce, and pine require less space than the oak, chestnut, elm, &c. The nature of the soil will determine the peculiar species of trees which should predominate in the plantation, and point out the distances at which they should be placed. If the soil is thin and of a light texture, the fir tribe should occupy the largest proportion, if not the whole space of land; if clayey, the oak, elm, ash, &c., should be the principal trees in the design; and, if a deep sandy soil, or if the soil be calcareous, elevated land, the beech, hornbeam, &c., ought to have the preference—all with the view to the ultimate produce of timber. The following table may be useful for readily pointing out the number of trees required for a statute acre of land, when planted at any of the undermentioned distances:—

| Distance apart. | Number of Plants. | Distance apart. | Number of Plants. |
|---|---|---|---|
| 1 foot | 43,560 | 10 feet | 435 |
| 1½ " | 19,360 | 11 " | 360 |
| 2 " | 10,890 | 12 " | 302 |
| 2½ " | 6,969 | 13 " | 257 |
| 3 " | 4,840 | 14 " | 222 |
| 3½ " | 3,556 | 15 " | 193 |
| 4 " | 2,722 | 16 " | 170 |
| 4½ " | 2,232 | 17 " | 150 |
| 5 " | 1,742 | 18 " | 134 |
| 6 " | 1,210 | 19 " | 122 |
| 7 " | 889 | 20 " | 108 |
| 8 " | 680 | 25 " | 69 |
| 9 " | 537 | 30 " | 49 |

In profitable forest-tree planting, the nearest distance at which young trees should be planted on their timber sites, is a yard, or three feet, and the widest space five feet; the medium distance of four feet plant from plant is, or ought to be, that most generally adopted. Seedlings of three years' growth, or plants which have remained two years in the seed-bed and one year in transplanted nursery rows, should be planted on their timber sites three feet apart every way, it being understood at the same time that the soil is thin, light, or sandy, and that the slit or holing in method of planting is used. But should the soil have been prepared by ploughing and trenching, and be in a clean fallow state, the medium distance of four feet, or three and a half feet, if the species of trees to be planted are exclusively of the fir or pine tribe, will be the most proper. Trees of the age now alluded to will vary in size from nine to twenty inches in height, exclusive of some species of poplar, elm, &c., which grow faster than the generality of forest trees. In well-prepared lan dof a deeper surface

soil than the above, plants from eighteen to twenty-four inches in height of the fir tribes may be planted with advantage; and deciduous trees, as the oak, chestnut, elm, &c., from three to four feet in height, may be planted at the distance of five feet apart. In the last case a return of profits from thinnings will be obtained at least two years earlier than from transplanted seedlings, under the like circumstances of soil. Trees planted as nurses for assisting the progress of those intended for timber are of quick growth, and in the course of from seven to twelve years will have attained to a size fit for the purposes of fencing, or to be used as poles, coopers' ware, &c., according to local demand. When the nurse trees have arrived at this stage of growth, they will require to be partially thinned, to make room for the timber trees, or *principals* of the plantation, as they are termed. Whenever the branches of the former interfere with those of the latter, no time should be lost in remedying the evil, by pruning the nurse trees, or cutting them down. If the different operations of planting have been judiciously performed, the value of the trees thinned out at this period will cover the rent of the land, with compound interest on the capital expended in planting it. Hence the importance of nurse trees, and the propriety of furnishing the ground at first with a sufficient number of young plants to be cut down and taken away periodically, until the principal timber trees have attained to maturity. In poor soils, where the original outlay of capital and the rent of the land are both small, the expenditure will be covered by the periodical crop of thinnings, and *vice versa* in better soils, authorizing a larger expenditure in the preparation, in the size of the plants, and in the mode of planting, a comparatively superior number of trees of increased value will be produced at each periodical thinning. These results are certain to follow judicious planting.

*The third and last mode of rearing forest trees proposed to be discussed* at the head of this chapter, is that of selecting the superior shoots of coppice stools, and training them to full-grown timber trees. The oak, on account of the value of its bark, is more frequently reared in this way than the elm*, ash, and chestnut. The timber of coppice trees is in general faulty, and of inferior quality to that reared from seeds. Where care, however, is taken in the selection of the shoots from healthy and not over-aged coppice stools, timber of the best quality may be obtained from them.

The produce of coppice stools consists of materials for fence wood, fuel, besoms, &c. Poles and bark are the most valuable of this produce, where the practice is to leave no standards, or saplings for timber. It is, however, perfectly clear, that when a wood or coppice offers to the purchaser produce of various sizes convertible to various uses, along with full-grown timber for navy purposes, the sale is more readily effected, and generally on better terms, than when the produce consists of smaller wood only. In making choice of the shoots of coppice stools to be trained for timber trees, great care should be had to select none but such as are straight and vigorous, and which originate as near to the roots of the stool as possible. The neglect of this latter circumstance is the chief cause of the unsoundness of coppice-reared timber, particularly at the root or *butt* end of the bole. The *parent wood* of coppice stools is most frequently suffered to rise too high from the roots, consequently the shoots emitted from it never grow with so much vigour, or attain to so great a size in a given space of

* *A great part of the elms (ulmus campestris) reared in Devonshire are from layers, and frequently defective at the most valuable part.—Vide Vancouver's Survey of Devon.*

One or two fertile tracts in Devon, where the soil is of the nature termed red sandstone, is more favourable to the growth of the elm than to any other tree.—*Mr. Kingston.*

time, as when the stool is kept within an inch or two of the surface of the ground. When the parent stool is a foot or more in height from the root, it becomes divided into pointed rugged parts, and if a tiller or shoot, left for a tree, is situated near to one or other of these, the *stub* is in time encompassed by the bark of the young tree wholly or partially, which causes blemish and unsoundness in the timber, as well as obstruction to its prosperous growth. The stumps of coppice stools should, therefore, be cut near to the surface of the ground, and the face of the *stubs* as level and free from fractures as can be. The kinds of trees most profitable for coppice produce are those which possess the reproductive power in the highest degree; these were before enumerated at page 34. It may be unnecessary here to observe that the non-reproductive trees, such as all the pine and fir tribes, are unfit for the purposes of coppice. The shoot, or tiller, being selected with due attention to these essential points, all other shoots belonging to the parent stool should be cut away close to the root. The young tree should then receive the same treatment as other trees reared by seed or transplanting. Although, under any circumstances, it cannot be recommended to convert a coppice wood into a timber grove, nevertheless, should the circumstance of local demand for timber trees be considerable, it is a highly profitable practice to allow a certain number of the most select oak tillers to remain for timber. Should the number finally left to become timber trees not exceed thirty on the space of an acre, the coppice produce will not receive any injury to be put in competition with the value of the trees retained. Were one hundred select tillers left on the cutting or fall of a coppice, and were the periodical falls made at eighteen years intervals of time, on the second cutting these tillers would be thirty-six years old, and worth from 10*s.* to 12*s.* each. At this period of growth twenty-five of the number should be taken away, leaving an average distance between those that remain of about twenty-four feet. At the next fall the trees will have attained to fifty-six years' growth, and will afford seventeen trees to be thinned out, of the value of 22*s.* each. At seventy-two years' growth the value will be increased to 38*s.* each tree, and allowing fifteen trees to be thinned out. At the fourth, or last thinning, the trees will be ninety years of growth, and worth at least 50*s.* each, leaving thirty timber trees, of which a part will be fit for ship-building, and exceed in value the fee-simple of the land. Land requiring a period of eighteen years to produce coppice-wood fit for cutting or a fall, cannot be worth more yearly than 10*s.* per acre in husbandry; consequently the rent of the land and cost of culture of the coppice is covered by these thinnings of the timber trees, leaving periodically the proper coppice produce, and at the termination of one hundred years the valuable trees above mentioned as clear profit.

The age at which coppices should be cut down varies according to the soil and their quickness of growth. Nine years may be considered the shortest period, and thirty years the longest, as oak-bark, which constitutes a valuable part of the produce, does not improve in quality after that age. Eighteen years' growth is about an average period for coppice-wood, and the average returns from bark and wood 21*l.* an acre*.

The comparative merits of the three different modes of rearing forest trees, proposed to be considered at the head of this chapter, will have appeared, from the facts brought forward, to be greatly in favour of transplanting young trees of proper sizes and age, from nursery beds to their timber sites, whether in regard to economy in the first and subse-

* There are instances of coppices affording returns of 50*l.* sterling profit per acre.

quent outlay of capital, in making and rearing the plantation, or in respect to the quantity and quality of timber produced on a given space of land, and in a given space of time. The rearing of oak timber from seed on the spots where the trees are to remain for timber is, however, an exception to the above conclusion under the following restrictions; namely, that the acorns of the best variety of oak (*Quercus robur vel longipedunculata*) can be obtained of good quality, at a reasonable cost, in sufficient quantities; that the land to be sown is in a perfectly clean state of culture, in *good heart* on the surface, and free from stagnant moisture; that labour is cheap; and that ample and complete protection from the attacks of vermin can be ensured to the acorns, and to the seedling plants till they equal in size three years' old nursery plants. When all these circumstances can be combined, then the mode of rearing the oak on its timber site from seed should be adopted, but not otherwise, or disappointment will be certain to follow.

*Simple plantations* consist of one or two species of trees only; *mixed plantations* of many different species. The latter, on suitable soils, are the most profitable; they afford an earlier, more permanent, and a larger return for capital than simple plantations. The judicious arrangement of the different forest trees, not only promotes the greatest returns of profit from the plantations, but likewise effects the highest embellishment to the estate and surrounding country*.

*Shelter* in winter and *shade* in summer are also important points. Evergreen trees, and such deciduous ones as retain their leaves to a later period of the year (the hornbeam, beech, and some varieties of the oak) afford much greater shelter in winter and in early spring, when it is most wanted, than those which lose their leaves early in autumn, and should, therefore, be planted wherever shelter is most desired. Shade is best afforded by trees which, rising with naked stems to a certain height, afterwards send out an extended series of branches, as the oak, beech, chestnut, and elm, which can be readily trained to that state by pruning, and their spreading branches and umbrageous foliage are highly superior for this intention than those of the ash, sycamore, plane, &c.

Although mixed planting, as just now observed, is the most profitable, and, under skilful massing and grouping, the most embellishing to the landscape, yet there are certain circumstances connected with the growth of the various species of forest-trees, which, when they occur, effectually control the choice of the planter in his modes of arrangement: these are, first, the peculiar nature of the soil to be planted; secondly, the climate, or the exposure and elevation of the site of the plantation. In planting, soils may be divided into *simple* and *mixed*. The latter allows of the fullest scope to mixed planting. *Simple* soils are those which contain the smallest number of ingredients in their composition, or which consist chiefly of one substance; as sandy soils, containing from nine-tenths of

* Planting the same sort of trees in masses was originally practised at Blair Adam, e. g. Half an acre of oaks, half an acre of beeches, half an acre of elms, half an acre of Spanish chestnuts, &c. This was altered for a mixture of different forest-trees, but Lord Chief Commissioner Adam has resorted recently to the original practice, especially on the sides of hills. His reason for this is, that mixing trees of different sorts (their growths being unequal) leads in thinning to sparing the more forward tree, though the tree of less value: whereas, uniting the same species of tree in masses, insured their growing pretty nearly in an equal degree, so that the choice in thinning secured the preservation of the best growing tree; and with regard to the effect of embellishment, the large masses of different colours, especially on the slope of a hill, appears to have more effect in point of grandeur than intermixture, the latter being more adapted to pleasure-grounds and the woodlands near a residence.

sand (the maximum at which the successful culture of the white field-turnip is supposed to be limited) to one-twentieth, the supposed point of absolute sterility for even common herbage, are properly termed simple sandy soils, and on which the pine, fir, larch, and perhaps the birch, can only be planted. Soils consisting of from seven-eighths to a larger proportion of chalk will rear the beech chiefly; and when the proportion of one-half of vegetable matter to one-half of sand and loam meet in a soil, it is properly simple vegetable earth, and comes under the denomination of peat, of which there are several kinds, but which will be more particularly mentioned under the head of soils. On this last-mentioned soil the planter is chiefly confined to the abele, poplar, and alder: the willow and birch only partially succeed, or when the vegetable matter is in a less proportion to the other ingredients above stated.

The elevation of the site of the intended plantation above the level of the sea, where that is considerable, influences the local climate so much as often to confine the choice of the planter to one or two species of trees only, even though the soil should be otherwise favourable for mixed planting.

It is calculated that an elevation of six hundred feet diminishes the temperature of a site equal to that of one degree of north latitude; the degree of dryness or humidity of the atmosphere, and the force of the winds seem also to increase in proportion to the elevation of the land. Accordingly we find that different species of trees occupy different regions and degrees of elevation on the mountains of the torrid, temperate, and frigid zones.

According to Humboldt, the trees which grow in the highest elevation are the pine and the birch, (these also it may be observed will flourish in the lowest situations, the birch in particular will grow in soils periodically overflowed or covered with water for two or three months in a year). The highest altitude of the growth of the pine is stated to be from twelve thousand to fifteen thousand feet above the level of the sea, in latitude 20°; and the limits of the growth of the oak appears to be confined to ten thousand three hundred. The last species of trees found nearest to the limits of perpetual snow on Mount Caucasus, in latitude 42½°, and on the Pyrenees, are the common birch (*Betula alba*), and the hooked pine (*Pinus uncinata*), and the red spruce fir (*Pinus rubra*). On the Alps, latitude from 45° to 46°, the common spruce appears limited to an elevation of about five thousand nine hundred feet. In Lapland the birch is found at the altitude of one thousand six hundred feet in latitude 67° and 70°.

The influence of different altitudes on the distribution and growth of forest trees, is evident even in the inferior elevations of the forests of Britain. The pine, fir, and birch occupy the highest points*; next the sycamore and mountain elm; lastly, the oak, beech, poplar, ash, and chestnut. When the ground to be planted is, therefore, so high above the level of the sea, as to influence materially the nature of the climate, the forest trees to be planted should be selected according to the above principles. In practice this may be termed *region planting*. By imitating the natural process in this respect, not only the most profitable returns which the site and soil are capable of producing will be secured, but also the most ornamental effects produced on the landscape, and the useful ones of judicious shelter obtained. It generally happens in extensive planting that the soil varies in different parts of the site in its properties and fitness

* *The Mountain ash occupies some of the most exposed of the Dartmoor Fens.—Mr. Kingston.*

to rear one species of tree better than another. When these different soils are, therefore, planted with the different trees best adapted to each, masses of diversified outline will adorn the landscape, having all the effect of a tasteful design, and the trees will be individually of the most healthy growth, a point of the last importance in ornamental effect.

Experience proves that, for elevated situations, the Scotch fir, *Pinus sylvestris*, the Norway spruce, *Pinus abies*, the larch, *Pinus larix*, the hooked pine, *Pinus uncinatus*, the birch, *Betula alba*, the sycamore, *Acer pseudo-platanus*, and the mountain ash, *Pyrus aucuparia*, are the most profitable: these, with the silver fir, *Pinus picea*, black Italian poplar, *Populus nigra*, the alder, *Alnus glutinosa*, and the Bedford Willow, *Salix Russelliana*, according to the soil, are also the best adapted to plant as nurses for rearing the more valuable timber trees.

For low, damp, and boggy soils, the alder, ash, birch, abele-tree, and the willow, are the best.

To resist the effects of the sea-blasts, the sycamore, pinaster, yew, and laburnum have all been found superior to most kinds of trees. The live oak is a very tender tree, and will not exist in England. The habits of the live oak (*Quercus virens*) offer a prospect of this tree being serviceable for the above important purpose. It is a native of South Carolina, and there it is seldom found above twelve miles from the sea-coast. It thrives best when growing on isolated spots or little islands entirely surrounded by salt water. On the estate of Middleburg, situated on the Cooper river, twenty-four miles from Charlton, South Carolina, belonging to J. Lucas, Esq. of New Cross, Surrey, live oak trees averaging twenty-five feet in height, and nine inches in diameter, were selected from the woods by that gentleman and planted in the form of an avenue to his residence. The trees were taken up with as many of the fibrous roots as possible. The tops were lightened by partially reducing the size and number of the branches. Every tree succeeded well, and in the space of two or three years from the time of transplanting they were not to be distinguished from those in the neighbourhood which had grown unmolested. These facts shew that this tree is of hardy vivacious habits, and being also an evergreen, warrants a fair trial of its merits on the coasts of England.

Transplanting trees of large growth for immediate effect properly belongs to another division of the subject, ornamental planting. It may not be unnecessary, however, to state shortly the principles of the practice as lately brought forward by Sir H. Stewart, in his *Planters' Guide*. These are to take up the tree, with all its roots, fibres, and rootlets, and also the green or external system of branches and buds entire and unbroken, then to transplant these roots, rootlets, and external system of the tree in the same perfect state. The soil into which such trees are transplanted should be of a superior quality to that from whence they were taken, or at least that portion of it applied immediately to the rootlets should have an addition of very rotten manure. A point of great importance to success is the selection of the subjects. 1st. The tree should have a superior thickness and induration of the bark compared to that of trees which have grown up in a crowded state. 2d. Stoutness and superior girt of stem. 3d. Numerousness of roots, fibres, and rootlets. And, 4th, extent, balance, and closeness of branches. Where a tree, otherwise desirable, possesses not these protecting properties, it should be provided with them previous to transplanting by uncovering the roots partially, so as not to injure the stability of the tree during the process. To these exposed roots is applied a compost of fine earth, into which they shoot, and produce in two or three years numerous rootlets fit for transplanting. The overgrown branches are reduced so

as to balance the top on every side, if it require it. To assist the bark, such trees as intercept the air and solar rays are removed. These effects are also produced to the roots by cutting a trench at a proper distance from the stem round the roots, and filling up the trench with good soil; in two or three years, the roots will be increased in numerous ramifications as in the former mode.

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## CHAPTER IV.

### *Of the Soils and Sites most profitably employed in the Growth of Timber; intimate Nature of different Soils peculiarly adapted for the Growth of particular species of Forest Trees.*

FROM what has been said respecting the advantages of judicious planting, the lands and sites most proper for the growth of timber will have been generally understood. There has been a difference of opinion whether land under woods or under tillage is the most profitable and beneficial to the proprietors and the public; the question is similar to that which exists respecting the comparative value of tillage land and permanent pasture, and may be solved in the same manner, viz., that the prosperity, if not the absolute existence, of the one is dependent on the other, and the interests of individuals as well as the public on both. The occupiers of land where woods are scarce, or wanting altogether, and those where they are in too great abundance, will coincide in the truth of this observation. The proportion which woods should bear to tillage and pasture lands in any one district of country depends on the nature of the soil, and the local demand for certain kinds of produce.

There can be but one opinion as to the advantages of planting exposed waste lands, and those that are steep, rocky, or precipitous. The loss to individuals and to the nation, by such large tracts of lands as those now alluded to lying utterly unproductive, is incalculable.

Lands of rather a superior quality to those, or which are accessible to the plough, and the barrenness of which is owing to exposure and ungenial climate, offer great inducements to forest-tree planting. For when the improvement is completed it is, to its extent, so much added to the territorial extent of the empire, in affording the means of sustenance as well as the enjoyment of human life*.

Lastly, where the local climate and soil are good, but where, at the

* From among the many instances to be found in Scotland of these effects produced by judicious planting in changing the face of nature from that of a desolate waste to comparative fertility and riches, may be particularly mentioned Blair Adam, the seat of the Lord Chief Commissioner Adam. Here land which, in its natural state, would scarcely afford any rent, has been so much improved by the skilful adaption of the different species of forest trees to the soil and site, the subsequent culture, and, above all, the judicious disposition or arrangement of the masses and narrower spaces of the plantations, as to render the shelter and amelioration of the local climate so genial as to produce corn and green crops as well as permanent pasture capable of rearing and fattening the improved breeds of stock (*a*). In England, barren moor soils have, in many instances of late years, been successfully planted. At East Court, in Berkshire, the seat of Charles Fyshe Palmer, Esq., M.P., a tract of extremely poor heath soil has been successfully planted by that gentleman. In a few years the aspect and climate of this before dreary, barren tract of land, will be completely changed. The plantations of Robert Denison, Esq., at Kilnwick Percy, Yorkshire, are arranged in the most judicious manner for shelter and improvement of the local climate. Mr. Hazlewood's larch plantations at Slaugham Park, in Sussex, are also arranged in the most effective manner for the improvement of the local climate. But there is scarcely a county in England where such barren soils existed, where examples may not be found of the beneficial effects of judicious planting.

(*a*) *Vide Appendix to the Agricultural Report of Kinrosshire.*

same time, a scarcity of timber exists for the periodical wants of agricultural and manufacturing operations, as for the various purposes of buildings, implements of husbandry, fencing, poles, machinery, fuel, &c., planting is of great importance and utility to the community*. In many cases, where the soil is of greater value, the planting may be confined to the angles of enclosures, and to hedge-rows.

In this last case it may be necessary to observe, that the land of the lowest comparative value for corn crops, and the most eligible for shelter and shade where required, should be chosen for planting.

When it happens that not all of these peculiarities of soil and site call imperiously for planting, it is proper to consider whether the value of timber or of coppice produce will not be greater from a given space of ground than that of corn or grass. The rent of the land will assist in determining the point, with the local demand for these crops. From numerous estimates of the returns from woodlands, compared to those of corn and pasture lands, under a variety of different circumstances, as to market for the produce, soils, and situations, 10*s.* per acre, per annum, of rent is considered the general maximum value of land, above which it ought not to be planted, but retained in corn or grass, and all land which rents under that value affords a very superior revenue under woods or plantations. There are undoubtedly many local circumstances which make exceptions to this rule; as where timber is scarce, or where the demand for certain kinds is unusually great, as in the neighbourhood of mines, hop-plantations, &c. There are instances on record of produce of the value of from 20*l.* to 60*l.* per acre, per annum, being afforded by woodlands; these, however, are extreme cases, and are here mentioned merely to show that exceptions may occur to the above mentioned rule; and that such returns are greater than can be expected from any other kind of crop whatever, particularly considering that the cost of culture, as repairs of fences, cutting down, and perhaps carting, is comparatively trifling to that of tillage and manuring, which every other crop of value besides wood requires.

It may be useful to take a more intimate view of the nature or composition of those varieties of soil which have now been alluded to. It is proper, however, to observe, that the following statements of the nature or constituents of these soils are not intended to convey the idea that they are the best sorts respectively for the different kinds of forest-trees, but principally to show that on such soils these trees have attained to great perfection of growth. The soils were selected from the spots where the trees mentioned in connexion with the soils were found by the writer of this treatise, and the trees were, on an average, the finest of the respective kinds which have come under his observation.

* The plantations made by the present Duke of Bedford are highly worthy of notice under this head of the subject, as being planned and executed in the most judicious manner. A statement of the number of trees and quantity of ground planted by John, Duke of Bedford, from the year 1802 to the present period, 1829; *viz.*

| | Quantity of Ground. A. | R. | P. | Number of Trees. |
|---|---|---|---|---|
| Bedfordshire and Buckinghamshire | 633 | 2 | 24 | 2,545,357 |
| | Exclusive of 400 bushels of acorns and other seeds dibbled in. | | | |
| | A. | R. | P. | Trees. |
| Devonshire and Cornwall | 819 | 0 | 0 | 2,859,754 |
| Huntingdon and Northamptonshire | 94 | 1 | 34 | 330,750 |
| | Exclusive of 280 bushels of acorns dibbled in. | | | |
| | A. | R. | P. | Trees. |
| Total quantity of ground planted | 1547 | 0 | 18 | 5,735,861 |
| | Exclusive of 680 bushels of acorns, and other seeds dibbled in. | | | |

The great importance of precision in the nomenclature of soils, whether in the details of planting or in husbandry, must be so clear and evident to every person who may be desirous to profit by the results of others' experience in these subjects, that it would be superfluous here to add more on the point.

1st.—Heath soil, or siliceous sandy moor soil, incumbent on shale or ferruginous stones, and frequently on siliceous sand of great depth.

| | |
|---|---|
| 400 parts consisted of fine siliceous sand | 320 |
| Carbonate of lime | 2 |
| Carbonate of magnesia | 1 |
| Decomposing vegetable matter, chiefly composed of the decaying leaves of heath | 55 |
| Silex, or impalpable earth of flints | 11 |
| Alumina, or pure matter of clay | 3 |
| Oxide of iron | 4 |
| Soluble matter, principally common salt, or muriate of soda | 4 |
| | 400 |

The Scotch fir, *Pinus sylvestris*, the birch, and the beech, are found to succeed better on a soil of the above description than any other kind of tree. For the latter, however, it is necessary that the subsoil should be a deep sand. The larch and spruce, under the like circumstances as to subsoil, will also attain to good perfection on heath soil; but where the subsoil is rocky, or impervious to a free circulation of moisture by indurated sand, which is sometimes the case, these last-mentioned trees never succeed; the Scotch fir only maintains its growth.

2nd.—400 parts of poor sandy soil, incumbent on shale, or very coarse gravel.

| | |
|---|---|
| Fine sand, principally siliceous | 360 |
| Impalpable earthy matter, 40 consisting of carbonate of lime | 0 |
| Decomposing vegetable matter, destructible by fire | 4 |
| Silex, or pure earth of flints | 22 |
| Alumina, or pure matter of clay | 7 |
| Oxide of iron | 5 |
| Soluble saline matters, chiefly muriate of soda | 2 |
| | 400 |

The pine, larch, spruce, birch, and sycamore are the most proper for this kind of soil.

3rd.—Sandy loam, incumbent on siliceous sand, containing a large proportion of oxide of iron.—400 parts.

| | |
|---|---|
| Fine sand, partly calcareous, and partly siliceous | 200 |
| Coarse sand | 84 |
| Carbonate of lime | 6 |
| Decomposing vegetable matter | 15 |
| Silex, or the earth of flints | 56 |
| Alumina | 12 |
| Oxide of iron | 5 |
| Soluble vegetable matter, containing sulphate of potash, vegetable extract, and common salt | 4 |
| Loss | 24 |
| | 400 |

The larch, pine, and fir tribe in general will succeed well on a soil of this texture, although the beech comes to the greatest perfection, or is, perhaps, the plant most profitable to employ in planting soils of this nature, particularly when the subsoil happens to be deep sand, as is the case of the soil on which the celebrated beech trees grow in Woburn Abbey Park. A figure of one of the finest of these trees is given in Pontey's *Forest Pruner.*

4th.—Light sandy siliceous soil, incumbent on a damp clayey subsoil.

| | |
|---|---|
| Siliceous sand, of various degrees of fineness | 290 |
| Gravel partly calcareous | 40 |
| Impalpable loamy matter, consisting of carbonate of lime | 5 |
| Silica, or earth of flints | 38 |
| Alumina or clay | 9 |
| Oxide of iron | 5 |
| Decomposing vegetable matter | 8 |
| Moisture and loss | 5 |
| | 400 |

The oak grows rapidly on this soil, and should constitute the principal timber tree of the plantation. The sweet chestnut also attains to great maturity in the same kind of soil. The nurse trees most proper are the larch, spruce, and particularly the silver fir. The elm planted on this soil had not attained to the size of the above mentioned trees in the same period from planting, but the timber was considered of a superior quality.

5th.—Clayey loam, incumbent on a clay subsoil.

| | |
|---|---|
| Coarse gravel, partly calcareous | 40 |
| Fine sand | 190 |
| Carbonate of lime | 16 |
| Decomposing vegetable fibre | 14 |
| Silex, or pure matter of flints | 90 |
| Alumina, or pure matter of clay | 30 |
| Oxide of iron | 7 |
| Soluble vegetable extract and saline matters, containing gypsum, common salt, and sulphate of potash | 5 |
| Loss and moisture | 8 |
| | 400 |

This soil brings the oak to the highest state of perfection. The above results of analysis were afforded by an average sample of the soil of a part of Woburn Abbey Park, where some of the finest oaks probably in England may be seen, excepting those of Lord Bagot at Blythfield Park. The following nine trees grow near together on the soil above described, and are therefore here selected to show the powers of a soil so constituted in the production of oak timber.

Oak No. 1.—The bole or stem measures, in timber, upwards of 50 feet in height, and the limbs extend from the stem 40 feet.

| | | | | Ft. | In. | |
|---|---|---|---|---|---|---|
| | At 3½ | feet from the | ground | 17 | 3 | circumference. |
| | At 10 | ditto | ditto | 14 | 6 | |
| | At 20 | ditto | ditto | 14 | 0 | |
| Oak No. 2.— | At 4 | ditto | ditto | 17 | 9 | |
| | At 7 | ditto | ditto | 15 | 6 | |
| | At 13 | ditto | ditto | 13 | 6 | |
| | At 20 | ditto | ditto | 12 | 9 | |

| | | | Ft. | In. |
|---|---|---|---|---|
| Oak No. 2.—At 35 feet from the ground | | | 11 | 4 |
| Oak No. 3.—At 4 | ditto | ditto | 13 | 0¼ |
| At 10 | ditto | ditto | 13 | 0 |
| At 20 | ditto | ditto | 12 | 0⅓ |
| Oak No. 4.—At 3 | ditto | ditto | 12 | 0½ |
| At 18 | ditto | ditto | 10 | 0 |
| At 66 | ditto | ditto | 8 | 0¼ |
| Oak No. 5.—At 4 | ditto | ditto | 14 | 0 |
| At 20 | ditto | ditto | 12 | 0⅓ |
| At 56 | ditto | ditto | 9 | 0½ |
| Oak No. 6.—At 3 | ditto | ditto | 14 | 4 |
| At 34 | ditto | ditto | 12 | 6 |
| The limbs extend from 40 to 46 feet from the bole. | | | | |
| Oak No. 7.—At 4 | ditto | ditto | 12 | 0 |
| At 50 | ditto | ditto | 8 | 0¼ |
| Oak No. 8.—At 4 | ditto | ditto | 13 | 0½ |
| At 12 | ditto | ditto | 11 | 0¾ |
| At 50 | ditto | ditto | 8 | 0½ |
| Oak No. 9.—At 3 | ditto | ditto | 13 | 0¼ |
| At 20 | ditto | ditto | 12 | 0 |
| At 48 | ditto | ditto | 8 | 0¾ |

The lowest estimate of timber in these nine trees is 3,200 cubic feet of the very best quality for naval architecture. It is remarkable, that though they must be of a great age, no symptoms of decay appear in the growth of these trees; they are perfectly sound and free from blemish*.

6th.—Damp clayey soil incumbent on clay.

| | |
|---|---|
| Coarse siliceous gravel | 60 |
| Fine sand | 120 |
| Vegetable matter, destructible by fire | 9 |
| Carbonate of lime | 15 |
| Silica, or earth of flints | 130 |
| Alumina, or pure clay | 48 |
| Oxide of iron | 10 |
| Soluble saline matter, with vegetable extract, and gypsum | 8 |
| | 400 |

The oak, elm, ash, and hornbeam attain to greater perfection here than any other kind of forest-tree. The tulip tree (*Liriodendron tulipifera*) grows freely on this soil when it is properly prepared by trenching. The Norway spruce, pinaster, and Weymouth pine appear to be the only species of the resinous tribe of trees that make tolerable growth on a soil of the nature above described.

* Lord Cowper's Pensanger Park oak, near Hertford, grows in a clay and sand soil or sandy loam.

| | Cubic measure. |
|---|---|
| In 1814, the stem of this tree measured 64 feet high | 629 feet. |
| One limb, 54 feet long | 67 |
| | 696 |
| Other limbs measured | 290 |
| | 986 |

This tree was again measured in 1826, and had increased to 1100 feet cubic measure. The first length of the tree, up to the first branch, is 17 feet, and 19 feet 6 inches in circumference, measuring in cubic contents about 400 feet.

7th.—Fertile peat moss, incumbent on clay or marl.

| | |
|---|---|
| Fine siliceous sand | 231 |
| Undecompounded vegetable fibre | 13 |
| Decomposing vegetable fibre | 57 |
| Silica, or impalpable earth of flints | 50 |
| Alumina, or pure matter of clay | 18 |
| Soluble matter, principally vegetable extract | 4 |
| Oxide of iron | 2 |
| Moisture and loss | 25 |
| | 400 |

This variety of peat soil when prepared for planting by draining off the superfluous moisture, with which it is found almost always saturated, is capable of growing very profitable trees, as the birch, abele, poplar, willow, and even the Scotch fir. A piece of ground of this nature, prepared by cutting open drains at such distances from each other, as to leave a sufficient breadth or body of earth to retain a due proportion of moisture in dry weather, and yet prevent saturation of moisture in the wettest weather, was planted with a variety of trees. The trees above mentioned succeeded remarkably well, and made an improved return of a hundred per cent. in comparison to that afforded by the natural produce of the surface. The following variety of peat, which is not uncommon, is to be carefully distinguished from the above:—

8th.—Inert* peat soil.

| | |
|---|---|
| Fine pure siliceous sand | 29 |
| Inert vegetable matter destructible by fire | 289 |
| Alumina | 14 |
| Oxide of iron | 30 |
| Soluble vegetable extractive matter, sulphate of iron, and sulphate of potash | 11 |
| Sulphate of lime | 12 |
| Loss and moisture | 15 |
| | 400 |

The outward characters or appearance of this soil is so similar to those of the first-mentioned variety of peat, that they are scarcely to be distinguished by common observation. The above soil, in its natural state, is absolutely sterile. Large applications of caustic lime and of common salt, in a smaller proportion, had the effect of improving the nature of this soil so much, as to render it capable of vegetating turnip seed, and of bringing the roots to the size of small turnips. It has not been proved, however, what the results of planting forest-trees might be on this soil, improved in the manner now stated.

9th.—Chalky soil, incumbent on chalk-rock.

| | |
|---|---|
| Calcareous sand | 280 |
| Carbonate of lime | 60 |
| Decomposing vegetable fibre | 5 |
| Silica | 28 |
| Alumina | 10 |
| Oxide of iron | 8 |
| Vegetable and saline soluble matters | 4 |
| Moisture and loss | 5 |
| | 400 |

* The inert or sterile property of this peat appears to arise chiefly from the excess of sulphate of iron and sulphate of potash and lime which it contains. When burnt, the ashes are found to be a valuable manure for chalky soils.

The beech, ash, and oak thrive better on a soil of the above composition, than any of the resinous or fir species of trees.

10th.—Rich alluvial or marsh soil, on the estate of Lord Saye and Sele at Belvidere, near Erith, in Kent, situated partly below and partly above the level of the river Thames.

| | Grains |
|---|---|
| Fine sand | 98 |
| Aluminous grit or stones | 68 |
| Carbonate of lime | 15 |
| Decomposing animal and vegetable matter | 40 |
| Silica or impalpable earth of flints | 115 |
| Alumina or pure matter of clay | 32 |
| Oxide of iron | 12 |
| Sulphate of lime or gypsum | 3 |
| Soluble vegetable extract and saline matters, giving indication of not more, or rather less, than the usual quantity found in soils generally of the muriate of soda or common salt | 6 |
| Moisture and loss | 11 |
| | 400 |

This soil had the character in the neighbourhood of being incapable of growing any kind of tree: it was supposed to contain an excess of common salt. The Hon. Twisleton Fiennes has put this interesting question to the test of trial. We examined this soil chemically as above, and found that common salt entered but little into its composition. The stagnant moisture with which it was surcharged appeared to be the chief, if not the only defect of the soil. The subsoil in part is peaty and incumbent on a clayey marl. A large open drain was made so as to command the water in the space set apart to be planted. The ground was properly trenched and thrown up into broad ridges, as recommended at p. 22 of this Treatise, with secondary drains between each ridge, communicating with the principal one. The ground was planted with a numerous variety of trees for the purpose of experiment. The results now obtained show that the poplar (*Poplus nigra*), willow (*Salix alba et Russelliana*), elm (*Ulmus montana*), sycamore (*Acer pseudo-platanus*), ash (*Fraxinus excelsior*), alder (*Alnus glutiosa*), locust (*Robinia pseudo-acacia*), birch (*Betula*), oak (*Quercus robur*), horse-chestnut (*Æsculus hippocastanum*), Spanish chestnut (*Castanea vesca*), hornbeam (*Carpinus betulus*), lime (*Tilia eur pœa*), spruce fir (*Pinus abies*), with dog-wood (*Cornus coccinea*), privet (*Ligustrum vulgare*), holly (*Ilex aquifolium*), and hazel (*Corylus avellara*), as underwood;—these different species of trees have succeeded in the order nearly as they have been enumerated, the first eight-mentioned sorts having, up to this period, a decided advantage over the others. The Hon. Mr. Fiennes purposes to continue and extend this interesting investigation; the results of which will decide the question, which is one of importance to the owners of soils of this nature.

Of the above varieties of soils, if we except the sandy loam No. 3, and the clayey loam No. 5, there is not one which, on its natural site, could be profitably cultivated under corn or green crops, but which, by skilful planting, might be made to return considerable profits to the owners, and also to the public the many advantages which judicious planting always confers.

Although there may be found shades of difference in the proportions of the constituents of soils receiving the same designation, such, for instance, as the poor sandy soil, containing ten per cent. more or less of sand in one situation more than another, yet the actual produce of timber,

all other circumstances being equal, will be found to vary but little, if any. But where the difference in the proportions of the ingredients is found so great as exists between the sandy loam No. 3, and the poor sandy soil No. 2, or, in a wood as between any two of the soils now attempted to be described from practical experience in their culture, as well as from a careful chemical examination of their properties and constitution, a very marked and decisive difference will be found in the comparative produce of timber, and in the peculiar species or kinds of trees which should have been planted in the greatest number, or in preference to others.

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## Chapter V.

*Of the most approved Modes of preparing different Soils for the reception of the Plants—Fencing, Draining, Ploughing, Trenching. Of the formation of Rides or Carriage-Ways into the interior of Plantations. O the best Mode of covering these with Herbage.*

In no improvement of landed property is economy in the first outlay of capital more essentially required than in forest planting. Want of attention to this important point has caused much loss to the country as well as to individuals, it having had the effect of discouraging forest planting generally, and more particularly of those lands emphatically termed wastes. The evil is perpetuated by statements confounding the expenses of planting different descriptions of land, such as that of a superior soil immediately connected perhaps with a mansion, and that of a distant hill or waste heath. In the former case the return of produce is early, great, and fully ample for every expense judiciously incurred in the plantation; while, at the same time, something must be allowed for obtaining the more immediate ornamental effect of wood. In the latter case the returns of profit are more distant, though equally certain, and the outlay of capital or expense of formation proportionally less. To estimate or make them equal to those of the first description of land, would be absurd, because unnecessary, and, in fact, impracticable, as in the case of rocky sites or thin heath soils, where the more expensive processes of the preparations of soils cannot be carried into effect. To say, therefore, that land cannot be profitably planted under a first outlay of ten pounds sterling an acre, or that the expense of planting should not exceed two, or at most three, is equally erroneous; although both statements, individually with reference to local circumstances, may be perfectly true and accurate.

Fencing is one of the most expensive but essential concomitants of planting; for unless young trees are completely protected by proper fences, extensive failure will be the certain consequence.

In general the materials fit for constructing plantation fences may be found on the spot. On sandy heath soils, the turf interwoven with the roots of heath or coarse herbage affords a ready and cheap material. We have seen a wall or *dyke*, built entirely of turf, last for a great number of years without wanting any repairs whatever. The turfs were cut to the depth of from three to five inches; according to the depth they were pervaded with the tough roots of grasses and heath, which tend to keep them firm and less assailable by the weather. This wall of turf was two feet wide at the foundation, and four feet and a half high, terminating at sixteen inches in thickness at the top. The turfs were built in rows alternately edgeways, and flat with the turf side downwards. The coping consisted of a row of turfs laid with the grass side upwards, and this continued permanent for many years. When the soil is clayey, or of a texture liable to

crumble by the effects of the weather, banks are thrown up four feet wide at bottom, four feet and a half high, and eighteen inches wide at the top. On the top a double row of furze should be sown, and the face of the bank defended from cattle by driving in stakes of forked larch or thorns, from two to two feet and a half in length. These stakes may be fixed in the bank about a fourth of the whole height of the bank from the furze, and pointing obliquely upwards. Where these stakes could be conveniently procured about the thickness of an inch and a half or upwards, we have found them to answer the purposes of a protection to the furze remarkably well: these are the cheapest modes of fencing a plantation. Where stones fit for building a dry stone wall prevail on the site, they may be used with great advantage for constructing the fence. In building a dry stone wall, i. e., without mortar or cement of any kind, it is of importance that occasional courses of stones of a size to reach across the thickness of the wall should be laid in; these act as ties, and render the wall strong and lasting. The coping is another point of importance to be attended to: the best coping is that composed of flat stones placed edgeways, and made compact and immovable by driving in wedges of stone at such distances from each other in the coping as will produce the desired effect, and a very little experience or practice will teach the workman to place these wedges in their proper points. The expense of constructing this kind of fence varies according to local circumstances. The cost of fences of this description is stated by Sir John Sinclair in his highly valuable work, the *Code of Agriculture*, to vary from 4*s.* 6*d.* to 6*s.* the perch, which agrees with the results of our inquiries and experience on the subject.

When neither of the above simple fences can be conveniently adopted, a *quick* or thorn hedge is the most generally used, and in fact is the best and cheapest. There are several kinds of *quick* fences, which differ merely in the mode of planting the thorns (*Cratægus oxycanthus*). The white thorn is a plant much checked in growth by every other, whether herbaceous weed or shub, that mingles with it in the soil. It delights in a strong loam, on poor sands, or damp clay; its growth is much slower, and requires great attention in the preparation of the soil, in the selection of the plants, and in the mode of planting. It must be carefully protected from cattle and rabbits, which, by nipping off the tender first shoots of the spring, seriously injure its growth, and defeat the intention of raising an effective fence at the least cost, and in the shortest space of time.

On poor sandy soils, the depth of earth for the reception of the plants should be made as great as possible, and they should be placed on the top of the bank*. Manure of rotten leaves, compost of marl or clay, and dung, ashes, or any substance that will enrich the line of planting, should be dug in if possible for the encouragement of the roots of the young quick. Where the soil is damp and clayey, planting the thorns on the face of the bank is the best practice. The ground should be perfectly clean, or the cost of weeding it afterwards will be considerable, and the fence will make little progress, if it do not fail altogether.

The cost of the manure above alluded to will be amply repaid by the more rapid growth of the quick, saving much of the expense of weeding, and of filling up blanks and gaps in the hedge, which always accompanies the rearing of this kind of fence on poor or badly prepared ungenial land. The size of the plants deserves particular attention, for by planting strong three year old transplanted thorns, the success of the fence is secured, and the distance of time for its completion shortened by three years. To

* *The Salix cinerea and one or two kindred species make useful and hardy fences if cut in the form of stakes, and driven in on the top lattice-form, seldom fail to strike root, and in the mean time form an effectual barrier.—Dr. Kingston.*

protect the thorns from cattle, a ditch with post and rails are adopted. (*Fig.* 8. *a*). When rabbits abound in the neighbourhood of a young quick fence, they are often very destructive to the plants. The means of preventing these animals from having access to the young thorns is too expensive to be adopted for forest fences*. A row of thickly planted dead hedge on each side of the row of quick, is, perhaps, the best temporary protection; but the most effectual mode is to keep down the number of the rabbits, or, if possible, to take them away altogether.

When stones can conveniently be had, the facing of the bank with these, and planting the quick so as to spring through the wall, (*fig.* 8. *b*,) forms the most secure and lasting fence. The expense of weeding is saved by it; and, under such circumstances, the plants generally make great progress.

In the management of the hedges when planted, weeding is most essential, for if coarse grass or rampant weeds are suffered to mingle with the lower branches and foliage of the quick, the injury is very considerable. The top of the hedge should be kept level from the first cutting, until the plants have attained to the desired height. The sides of the hedge ought to be kept also of an even surface; by shortening the side branches every year to within an inch more or less of the preceding year's wood, the bottom of the hedge is maintained equally thick and impenetrable with the upper portion. The most generally approved form of a hedge, is that of the hog's mane; however, if the soil has been properly prepared, the plants selected of the largest size, and the keeping clear of weeds, and most judicious mode of pruning persevered in, the hedge will flourish in every shape.

*Fig.* 8.

By keeping the top of a hedge level, it is not meant that all the plants should be shortened in the leading shoot of the stem, but only those which overtop their thin neighbours. If this be properly attended to, the evil effects which follow the practice of shortening without exception the leading shoots of every plant of the hedge will be avoided, as well as those which occur when the upright growth of any plant is left uncontrolled until it reach to the desired height.

Where a hedge has been neglected, is overgrown and irregular, the best mode is to cut it down level with the soil, and then to dig the earth about the stumps, inserting plants of strong quick in the gaps where they occur. It may happen that the fence cannot be dispensed with, for the time the young shoots from the old roots require to renew the fence. In this case, the mode of cutting a fourth part of the stems to the desired height, and another fourth part a few inches from the ground, and warping the remainder with these, is found a useful practice.

Besides the white thorn or quick, and the furze (*Ulex europæus*), there are many other shrubs which may be planted under certain circumstances with effect as fences. In exposed cold soils, the Huntingdon willow, beech, birch, and alder, may be used with advantage.

It may be unnecessary to mention, that where larch poles can be had, they afford an excellent material for fencing, particularly when used with

* For protection to gardens against the depredations of rabbits, or turnip crops exposed in the fields, &c., a wire netting has been invented, which completely answers the purpose. The expense for these purposes is so moderate, as to render the adoption of the wire netting no matter of difficulty. We witnessed the effects of the practice at Cantley Hall, the seat f John W. Childers, Esq.

the bark, which tends to preserve the wood from the effects of moisture and air*.

*Draining* is essential wherever stagnant moisture prevails in the soil. Boggy lands and tenaceous clays are chiefly the soils which require it, for trees will thrive in a degree of moisture that would be highly hurtful to the nutritive grasses, and to corn crops. Under drains are of little service for forest-trees, as their roots soon render these ineffective. In general, therefore, open cuts should be used. Where the excess of dampness is caused by springs, as in most bogs and morasses, it is essential to ascertain the source of the principal springs which feed the secondary ones, and their numerous outlets over the surface. Sub-aquatic plants, as the alder, rushes, &c., often point out the spots where the search should be made, although these plants are frequently supported by stagnant surface water. Boring with the auger is the best mode of ascertaining the source of the spring, or at least that level of its course in the strata which conducts the water to the boggy land, and where it can be effectually cut off from supplying the secondary springs and outlets in the lower levels. When the source is ascertained, a drain should be cut to the depth of the strata through which it passes, so as to obstruct its progress. It should be made sufficiently deep, or the water will continue to pass under it, and the work will be useless. From this main drain formed across the declivity, other secondary drains should be made to conduct the water thus collected, from the source to the most convenient outlet. It would be incompatible with the space of these pages to enter into details of this subject. Elkington's mode of draining, as given in Johnstone's Treatise on the subject, is on the above principle, and shews with precision the advantages of it, and with how much facility lands, which by the old method of draining were considered incapable of being profitably improved, may be made fit for planting and returning a valuable produce of timber.

Clayey soils which are rendered barren by surface water stagnating upon them, may be made to produce valuable timber by the simple process of constructing open drains, and forming the surface between these into ridges, as before mentioned in Chapter III.

On steep acclivities, rocky soils, and thin heath, or moor lands, incumbent on rock or shale, where ploughing or trenching is impracticable, a depth of pulverized soil cannot be obtained for the reception of the roots of trees of more than two, or at most three years' growth; the mattock planter, diamond dibble, and spade, can be used with the best effect. To attempt any more expensive preparation on such lands, than may be made by these implements for the reception of the individual plants, would be injudicious. The number of valuable woods which have been reared in this way, are too generally known to need particular mention here. The cost may be stated to be from two to five pounds per acre. For the preparation of heath soils, incumbent on sand or loose gravel, an improved paring plough (*fig.* 9 and 10), which we call Fyshe Palmer's planting plough†, is a valuable implement.

The plough consists of two mold boards as in common use, but resting on a triangular and somewhat convex plate of iron (*fig.* 9). This iron

* It is the opinion of some practical persons, that the bark being left on larch poles, encourages or attracts insects to nestle under it, and thereby hastens the decay of the wood, unless it happen that the trees are cut down in winter, or when the sap is down.—*Mr. Lance.*

† Charles Fyshe Palmer, Esq. M.P., in planting a large tract of waste land on his estate of East Court in Berkshire, after various trials, found this plough which he invented a most effective implement in paring off the heath-turf. It economises time as well as expense.

plate is furnished with sharp steel edges riveted to it (*fig.* 10, *c*). The fixed share (*a*, *fig.* 10), which divides the turf for each side of the double moldboard, is six inches high at the shoulder, with a sharp edge tapering to a point at (*b*). The sole of the plough is screwed and bolted to the instrument by the bolt sockets (*e*), and the nut screw sockets (*d*). The base of the triangular plate *f* (*fig.* 9) is twenty-one inches, with a curve of one inch, which facilitates the action of the instrument when paring in gravelly or stony ground. The whole length of the plate is thirty-five inches from the base (*f*) to the point of the share (*b*). Wherever the land is of a moderately level surface, and when paring is desirable, this plough will be found a valuable implement. The whole surface may be pared as in clayey soils, where burning the turf is essential; or spaces of twenty-one inches, as in heath soils, may be pared off with intervals of thirteen inches, on which the reversed turf may rest to decay, and become food for the roots of the trees. When the soil is of sufficient depth to allow of trenching, the common plough, following the track of the paring plough, will effect this object at a comparatively small expense.

*Fig.* 9.

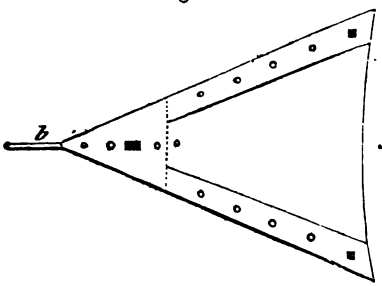
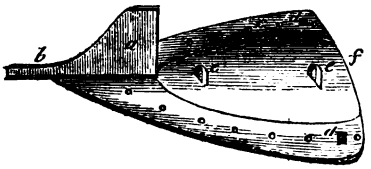



*Fig.* 10.




Much difference of opinion prevails on the comparative advantages and disadvantages of trenching ground for forest trees; nothing is more certain than that trenching and manuring is more advantageous to the trees than holing, or any other mode of preparation. But there are certain soils which will produce valuable timber, and that cannot be ploughed or trenched; these have already been mentioned: there are others which are capable of receiving benefit from this mode of preparation, but where it would be inexpedient to bestow it. There is one instance in which trenching cannot on any account be dispensed with, which is that of ground near a mansion, where the value of trees in respect to landscape effect, shelter, shade, concealment, and the improvement of local climate, have equal if not superior claims to that of the actual value of the timber produced by the individual trees of the plantation. The question as regards other sites and soils, intermediate between these two now mentioned, and of a nature as regards texture and quality similar to the soils described in Chapter IV., under the numbers 3, 4, 5 and 6, which are capable of rearing mixed plantation, or a variety of different species of forest trees in perfection, the process of trenching or ploughing, and also manuring when possible, ought to be adopted. In this instance, however, it is highly necessary, before adopting the more expensive preparation, to ascertain exactly the cost of each mode of planting, and the probable return of profit from the outlay. As many local circumstances interfere with the performance of these different processes, as the comparative cheapness of labour, of manure, the facility of obtaining the most proper sized plants, to anticipate two or three years' earlier return of produce, &c., it would be of little use here to give any calculations of expense and profits, as data by which to estimate the results of either mode of practice, that would be applicable

to every soil and site alluded to. Where the local demand for the smaller sized products of plantations are great, the more expensive process of trenching should be adopted, inasmuch as the growth of forest-trees to the size of poles, and of materials for fencing, &c., is highly promoted by trenching and manuring, and the returns of profits from these products of planting are in proportion earlier and larger. That this superiority extends in the same proportion to the ultimate produce of timber in trees, may not appear so clear, because it may be urged by those who undervalue trenching and manuring as preparation of the soil for planting forest-trees, that there are no satisfactory records of the comparative rate of increase of timber, or of solid vegetable fibre, after the first twenty or thirty years' growth of the different species of forest-trees, which have been planted on trenched and manured grounds, and the contrary, being under all other circumstances the same until their last stage of perfection; and yet the truth of such continued superiority of increase, is the only test by which the question can be decided, and an unerring rule of practice be obtained. The results of mere observation, or conclusions drawn from the apparent contents of trees, will not be found to warrant the adoption of any new mode of practice. But the comparative increase and ultimate produce of timber should be ascertained up to the period of the trees attaining to perfect maturity in the most satisfactory manner, by actual admeasurement; and correct records kept of the age of the trees, comparative value of the plants when planted as to their size, roots, and constitutional vigour at the time of planting; as also the intimate nature of the soil, subsoil, and local climate. In the oak, after the first fifty or sixty years' growth, the annual rate of increase of the diameter diminishes greatly. The Lambert pine-tree (*Pinus Lambertiana*), mentioned in the *Trans. Linn. Society*, vol. xv. p. 497, exhibited an increase of diameter of four inches and a half only at the base, during the last fifty-six years of its growth.

These last remarks apply to the question generally; but in all cases of exception before mentioned, and in the instances of clayey, tenacious soils, and compact gravelly loams, trenching ought doubtless to be adopted as a preparation for the reception of forest-trees*.

* The advantages of trenching have been zealously and ably advocated in a late publication by Mr. Withers, to which we have already referred, and the proofs brought forward in support of his arguments are satisfactory as far as they go; but the most important facts are those of the superior increase, and the comparative quality of the timber when the trees have attained to full maturity. Registers of the facts stated by Mr. Withers, continued until the trees attain to full timber size, and of the buildings or purposes to which, in certain cases, the timber is applied, are what would afford invaluable information, and for which posterity would be grateful. A distinguished writer asserts that after the first twelve or twenty years of growth of trees planted on land prepared by trenching, all distinction is lost between the *apparent* growth of these and of those which may have been planted by the simple process of holing. In general cases, the observations of the writer of this have led to precisely the same conclusions. It is improbable, however, that the superior growth which so distinctly marked the progress of the plants on the trenched ground during the first years of growth should wholly cease, but that it diminishes in proportion as the soil, which had been loosened by the process, becomes consolidated to its original state, and in proportion as the roots advance in the subsoil which had remained equally undisturbed in the execution of both modes of preparation, is quite certain. Whether this superior rate of produce, though reduced in degree, continues until the tree attains to perfect maturity, or ceases before that period, we have certainly no records of facts to shew. Farther, as regards the progressive increase of wood in trees, different species vary in this particular. The locust, for instance, will make shoots of six feet in length for a few of the first years of its growth, or, if cut down when in a healthy state, will produce in one season shoots of three yards or more in length; but to conclude from this circumstance that the locust is one of the fastest growing trees, or even that it is equal in this respect to the slow growing oak, would be erroneous, inasmuch as, at its fifteenth

In order to have at all times the most convenient as well as the most pleasant access to the interior of the plantation, rides or broad drives should be marked out and left unplanted. On heaths and gravelly soils the surface is in general so level and unbroken as to require the lines or edges of the rides merely to be cut out in the form of a shallow water-course, any inequalities of the surface to be made good with the turf or earth taken out. In damp, clayey soils, the rides should be made higher in the middle and sloping on each side to an open drain, marking the line of each side*. The earth should be made fine and sown with the following grass seeds, *viz.*, *Alopecurus pratensis*, *Dactylis glomerata*, *Lolium perenne*, *Cynosurus cristatus*, *Phleum pratense*, *Anthoxanthum odoratum*, *Poa trivialis*, *Festuca pratensis*, with red and white clovers combined, at the rate of four bushels and a half to an acre. For dry, sandy, heath soils, which can scarcely be covered with verdure, the following will be found effectual:—*Festuca*

year of growth, the annual rate of increase in height is found to be reduced to inches instead of yards or feet, and at the age of thirty or forty years it may be said to cease altogether to advance in stature; while the oak, which has before this period overtopped the locust, continues its comparatively steady annual increase for a century. And, with certain modifications of the rate of annual increase between the first and subsequent stages of growth to perfection, the same principles will apply to the willow (*a*), poplar, alder, birch and the pine tribe, on the one hand, and to the oak, chestnut, elm, beech, ash, &c., on the other.

(*a*) The Bedford willow (Salix Russelliana) when planted on a damp, clayey loam, on a rising site, has been observed by the writer of this to attain to the height of thirty feet in five years, but after that the annual rate of increase diminished to inches, and then the tree became in appearance stationary. The celebrated willow in Staffordshire, known under the name of Doctor Johnson's Willow, is of this species. Since the above was sent to the press we have had the gratification of perusing the *Salictum Woburnense*, or a catalogue of the willows indigenous and foreign in the collection of the Duke of Bedford, at Woburn Abbey. This contains the fullest account of all the different species of this interesting tribe of plants that has yet appeared. As regards the willow above alluded to, it is observed in the introduction to the work by the noble author, that 'the Rev. Mr. Dickenson assured Sir James Smith and myself that the great willow at Lichfield (commonly called Johnson's willow, from a belief that it had been planted by him) was of this species. Dr. Johnson never failed to visit this willow when he went to Lichfield.' In 1781 it was reported to be nearly eighty years old, and Mr. Dickenson says, 'the venerable sage delighted to recline under its shade.' The noble author further observes, 'I can state another instance from my own personal knowledge of this species of willow attaining a great size within the ordinary period of a man's life. A willow-tree on the south lawn at Gordon Castle, in Scotland, was planted by the late Duke of Gordon about 1765; it was then in a small box four feet square, floating on the surface of the lake, and shortly sank on the spot, where it took root. The lake has long since disappeared, and the tree was blown down in a storm on the 24th November, 1826, the tree being then sixty-one years old. I examined this tree a few years ago, and found it to be the *Salix Russelliana* of Sir J. E. Smith.'—*Salictum Woburnense*, Introduction, vi.

* At Blair Adam, in many instances, the plantations were originally made with broad rides; in others where that was omitted in the original planting, it has been accomplished by cutting out the trees. These, while the plantations were young, served the double purpose of access, for the convenience of carrying out the thinnings and for pleasure, because then it was possible to proportion the loading of the carriage, by putting a greater or smaller number of trees, according to the state of the rides in point of moisture or distance; but now that one tree makes a load, and that its weight cannot be diminished, the injury done to the ridings was so great as to impede both the convenience and the pleasure of the rides, and great expense was incurred in putting them in repair. To avoid this, what are called wood or thinning lanes have been adopted, by cutting out trees in proper lines for them; this shortens distances to the place of deposit (for rides are always circuitous) and is of benefit to the woods by admitting air more generally, care being taken that they are so twisted as not to incur the risk of being blown down. It is proposed (as they are easily got) to fill the rutts with broken stones. Where stones are not easily to be got, the rutts might be filled with trees not otherwise useful, so as to make a sort of coarse railway. This plan will, in the end, save a great deal of expense and labour, and secures at all times the proprietor's access to the woods and his seeing what is going on.

*ovina, Festuca duriuscula, Aira cæspitosa, Aira flexuosa, Cynosurus cristatus, Agrostis stolonifera* and *vulgaris, Achillea millefolium, Trifolium minus*, and white clover. Game are fond of these grasses.

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## Chapter VI.

*Of the Culture of Plantations; Soil; Pruning; Thinning; remedies for accidental injuries and Natural Diseases of Forest Trees. Of the Tanning afforded by the Bark of different Species of Trees.*

The judicious culture of plantations is a point of the last importance to secure a full return of profits from the capital expended in their formation, as well as for every other advantage that judicious planting confers; for let the care and skill employed in their formation have been ever so great, if the proper culture be not continued from the period of planting to maturity of growth, disappointment in obtaining the effects of wood, and loss of profits will be the certain results. The numerous instances to be seen almost everywhere of the bad effects resulting from the neglect of judicious pruning and thinning of the trees of plantations, and the great loss caused thereby to the proprietors, evince fully the importance of this branch of the subject, which embraces the following points:—

1st. Culture of the soil.
2d. Pruning.
3d. Thinning.
4th. Remedies for accidental injuries, or natural diseases.

First. The culture of a trenched soil of a newly-formed plantation, consists in keeping the surface clean of weeds until the shade of the trees prevents their growth. It is true that these weeds take a portion of nourishment from the soil, but from what was before stated regarding the food supplied to the plants by the soil, it is clear that the growth of herbaceous weeds can injure but little, if in any degree, the growth of forest-trees. When the trees are young and of a small size, however, the mechanical effects of these weeds are extremely hurtful when they are suffered to grow and mingle their shoots with the lower branches of the young trees, by obstructing the free circulation of air, and preventing the genial influence of the solar rays from reaching to their tender shoots, and this is evident to common observation in the decay or death of the branches subjected to contact with them, and in the consequent unhealthy appearance of the leading shoot of the tree.

Hoeing the surface as often as may be required to prevent perennial weeds from forming perfect leaves and new roots, and annual weeds from perfecting seeds, is all that is required. Two seasons of strict adherence to this rule, even in the worst cases, will render the labour or expense of future years comparatively trifling, and the healthy progress of the trees will reward the care and attention.

On soils planted by the slit, or holing-in mode of planting, it is essentially necessary to prevent the natural herbage of the soil from mingling with the lateral branches of the young tree. An active workman with a steel mattock-hoe will clean round the plants on a large space of ground in a day. Summer is the best season for the work, as the weeds are more effectually destroyed, and the partial stirring of the soil about the roots of such plants as require cleaning benefits their growth.

Should the planting and culture now described have been faithfully

executed, there will be few failures. When these happen, however, the vacancies must be filled up, at the proper season, with stout plants, and the holes be properly prepared for the reception of the roots. It is a good practice for the first two or three years of a trenched plantation to take a crop of potatoes, mangel wurzel, or carrots, according to circumstances. The rule, which must be strictly adhered to in the introduction of these crops, is, that no part of the foliage or tops of the green crop touch or even approximate near to the young trees; a rule of practice which, if broken through, produces equal damage as from a rampant crop of weeds to the plantation.

Second. There are three different kinds or modes of pruning, which, in practice, have been named close pruning (*a*, *fig.* 11). Snag pruning (*b*), and foreshortening (*c*).

*Fig.* 11.

By leaving a snag (*b*) of the branch, it in time forms a blemish in the timber, in consequence of young wood forming round the stump, and embedding it in the tree. Snag pruning is the most rude and injudicious mode that can be practised, being invariably attended with injury to the quality of the timber: it should never be adopted under any circumstances whatever. Close pruning (*a*) is performed by sawing or cutting off a branch close to its parent stem or primary leading branch (*c*). This is the only mode to be adopted in training, or rather improving, the stem or bole of a tree, or wherever it is desirable that no reproduction of branches from the point should follow. The most perfect manner of executing the work is to saw the branch off close to the parent stem, and smooth any roughness that may be left on the surface of the wound with a sharp knife, taking care not to reduce the edges of the bark which surround the wound more than is actually necessary to remove the lacerated surface. To prevent the action of air and moisture on the naked wood, a dressing should be applied, composed of ingredients that will adhere to the spot, and resist the action of drought and rain. Three parts of cow-dung and one of sifted lime will be found a very effective substitute for the more compound dressing of Forsyth. The dressing should be laid on one-quarter of an inch in thickness, or more when the wound is large: when rendered smooth and firmly pressed to the part, powdered lime should be thrown over the surface, and pressed into it by the flat side of the pruning knife, or a spatula. The bark will sooner cover the wound when protected from the influence of the weather by this or by any similar means, than when left naked and exposed*.

In general forest pruning this process is unnecessary, or rather the benefit is not sufficiently great to warrant its cost; but for particular trees connected with ornamental effects it is well worth the trouble.

*Fore-shortening* pruning (*c*) is the only one that can be usefully practised

* The fate of Mr. Forsyth's discovery of a composition applied to heal the wounds of trees, and to renovate decaying vital functions of vegetable growth, is similar to that of all other discoveries where the principles of such are pushed too far. Hence, one party ridicules it as good for nothing, and another pronounces it as infallible; while the truth lies between. In a long practice the writer of this has always used it with beneficial effects in every case where it was more than usually desired to have the bark speedily closed over a wound in a tree, but for the ordinary cases of forest-tree pruning it has never been used, and for the reasons before stated.

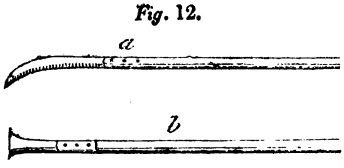
in reducing the size of lateral branches. When these become too crowded, or when particular ones assume a disproportionate vigour of growth and increase, it is highly useful to reduce the number or size of such over-luxuriant branches. The chief point to be attended to in the operation is that of dividing the branch at a point from whence a healthy secondary branchlet springs, that it may become the leader to that branch. When the shoot is of one year's growth only, and has no lateral shoots, as in stone-fruits trained on walls, the division is made near to a strong healthy bud, which will become the conducting shoot.

For young forest-trees which require the branches to be regulated and balanced, so that one side may not have a disproportionate number or weight of branches to the other, and for trees in hedge-rows whose lateral branches extend too far on either side, injuring the quick fence or the crops of the field, fore-shortening is the most useful mode of pruning.

For non-reproductive trees, such as all the different species of the pine or fir tribe of forest-trees, this mode of pruning is improper, as the branch thus shortened does not produce a second shoot, but remains with all the objectionable properties of a *snag*, to the great injury, in time, of the quality of the timber. Where the purposes of evergreen masks, near the ground, in the margins of plantations are desirable, the foreshortening of the leading shoots of spruce firs, &c., is highly useful, as these trees do not afterwards increase in height, but only extend laterally by thin side branches.

The most effectual pruning instruments are a strong knife, hook, saw, and chisel. For pruning elevated branches a small saw firmly fixed to a long handle is highly useful (*fig.* 12, *a*); a chisel, likewise furnished with a long handle (*b*), and driven by a hand mallet, is very effective in taking off branches close to the stem or bole, in circumstances where the saw cannot be freely used from the upright direction of the branch, or the situation of the adjoining branches. Such are the manuals of forest-pruning. It may be justly said that in no one process of the culture of forest-trees is a just knowledge of vegetable physiology, or that of the structure and functions of the organs of vegetable life of more importance than in this one of pruning, which directly and especially applies to the assisting and directing, as well as the checking, of these functions in the production of wood as in forest-trees, and in that as well as of flowers and fruit in garden-trees. Some of the leading points of vegetable physiology which bear directly on the practice of pruning, have been mentioned in Chapter III., and full details may be obtained in the work there cited.

*Fig.* 12.




A timber tree, as before observed, is valued for the length, straightness, and solidity of its stem. Judicious pruning tends greatly to assist nature in the formation of the stem in this perfect state. In natural forests, boles or stems possessing properties of the most valuable kind are found, where no pruning, trenching, or any other process of culture ever was applied to the rearing of the trees. It should not, however, be concluded from this circumstance that these processes are of little value. If we examine the growth of trees in this climate, when left to the unassisted efforts of nature by the neglect of pruning and thinning, we find that but a small number only, on any given space of planted ground, attain to perfect maturity, compared to those which never arrive at any value but for fuel. The like results, though varying according to local advantages, are exhibited in the produce.

of self-planted forests. Hence, instead of an average of two or three perfect trees on any given space (suppose an acre) left by the unassisted efforts of nature, we shall have from forty to three hundred perfect trees, according to the species of timber, by the judicious application of art in the preparation of the soil and the after culture of the trees, and probably on soils, too, which, without such assistance, could never have reared a single tree.

But though judicious pruning greatly assists in the production of a tall, straight bole, free from blemish, yet unless those circumstances before mentioned are favourable, as a vigorous, healthy constitution of the plant in its seedling stage of growth, transplantation to its timber sites at a proper age, and a soil suitably prepared and adapted to the species of tree, pruning will be found but of small efficacy*.

It was supposed that when branches are taken from a tree, so many organs of waste are cut off; and it has been practically insisted upon that, by the removal of large branches, the supply of sap and nourishment which went to their support would go to a proportionate increase of the stem. From what has already been stated respecting the course and movement of the sap, it may be unnecessary to add that this opinion is erroneous in principle, and that when a branch is cut off a portion of nourishment to the stem is cut off also specifically from that part of it which lies between the origin of the branch and the root, downwards to the root. Every branch of a tree, of whatever size it may be, not only draws nourishment and increase of substance from that part of the stem which stands under it, and from the roots, but also supplies these with a due proportion of nourishment in return, and by which their substance is increased. If the branch, whether large or small, acted merely as a drain on the vessels of the stem, and that the sap it derived from it was elevated to the leaves of the branch, and from thence returned no farther than to the origin or point of its union with the stem, then the above opinion would be correct: on the contrary, however, when it is found that the existence and increase of every twig, branch, and leaf, depends on a communication with the root, and that this communication passes through the stem downwards to that organ, and from it upwards periodically, and, moreover, that every periodical series of new vessels thus formed in the branch has a corre-

* At Blair Adam pruning was resorted to, in some instances, where the trees were too far advanced in age for that operation, but it was rendered necessary, in those instances, by due attention not having been paid to those portions of the wood at an earlier period. The rule then and there followed was, not to cut off any branch which left a horizontal surface exposed: they were cut so as to have the surface of the cut in the line of the stem, with a very sharp heavy bill, at the time the sap was rising: the effect of this was uniformly to secure a considerable growth of the bark over the wound before winter set in. This has obtained stem for the trees that were so treated, but it is greatly feared that when they are put to use, there may be weaknesses (in the dockyards called blanks) at the parts where the pruning has taken place.

To make valuable wood, length of stem is essential, and the practice at Blair Adam, in consequence of experience, has been to obtain this by knife pruning in the earlier years, by bill pruning as they grow older (say to twenty-five years, when the lateral branches are easily cut and soon barked over), then by leaving them to press upon each other more severely than vigorous thinners would permit.

Two effects seem to be produced by this:—First, they draw each other up to stem;—secondly, they produce a certain decay in the lower lateral branches. When those effects are sufficiently attained, and before any risk is incurred to the power of the tree to obtain thickness, the thinning is commenced by gradually, and according to the best judgment that can be formed, taking out the inferior trees and those best grown trees which injure each other, but taking care to do this so gradually as to secure against any chill or sudden effect of cold, so as to bring about (what may be called) the injury of being bark-bound,—the most effectual impediment to growth either in height or thickness.

sponding series of vessels formed in the stem from its point of emitting the branch to the root, it is clear that a branch not only increases in substance by the functions of its own organization, but must, of a necessity, periodically increase the substance or diameter of the trunk.

The results of practice agree with this; for if an overgrown limb or branch of a free-growing tree be pruned off, the annual increase of the diameter of the stem is not found to exceed its previous rate of increase; or the excess, if any, is not equal to the contents of wood which had been periodically formed by the branch or branches thus separated from the stem*.

It is reasonable to inquire, if the sap or nutritive fluid, periodically supplied by the roots immediately connected with the large branch taken off goes not to a proportionate increase of the stem, to what channel is it directed? It has already been mentioned (in Chapter III.) that the vessels which convey the periodical supply, and the roots which collect it, are annually produced; and the fact is, that when the primary organs and stimulus of production, (i. e. the leaves and green system of the plant,) are taken away, the annual rootlets and spongeols connected with these vessels cease to be renewed, until another branch, or series of branches, are reproduced by the vital power acting on the sap in the vessels of the stem connected with the numerous latent germs of buds in the bark near to the wound, or those dispersed in its neighbourhood. Hence it is, also, that should the season of the year of pruning the branch be that in which the sap is accumulated in the largest quantity in the leaves, and in the smallest proportion in the vessels, scarcely any reproduction of branches follows the operation of pruning; and hence, also, the different effects of summer and of winter pruning as regards this point.

When branches are not allowed to perfect one year's growth, but are pruned off annually within a bud or two of their origin with the stem, they act rather as organs of waste than those of increase of wood to the stem. But although the rate of periodical increase of the diameter of a tree be thus lessened, in a certain extent, by the loss of a full grown lateral branch, yet the increase of the stem in height or length is not thereby retarded, the ligneous vessels of the root corresponding with those of the stem or wood, probably act with but little diminished force in sending up sap to the higher extremities of the tree†.

It is of great importance that branches which indicate an over-luxuriant growth should never be suffered to become large, or to exceed the medium size of the majority of the boughs of the tree, but should be pruned off close to the stem when the general interests of the plant will admit of it. These over-luxuriant branches, which, when suffered to take the lead in growth of the general boughs, become so hurtful to the perfection of growth of the stem, are evidently produced and supported by the accidental circumstance of a superior portion of soil being in the way of,

* In numerous and varied trials made by the writer to ascertain this point, the results have always gone to prove the above facts.

† In a few instances, for the sake of particular effect, and to enable carriages to pass, there have been, at Blair Adam, limbs of considerable size cut from oaks of fifty years old and upwards. The cut would have been horizontal; but by making the surface of much greater size, they were made perpendicular. By great attention, all injury was prevented to the trunk, and the wounds are now healed over (at the distance of twelve or fifteen years from the date of the operation). Whether it has accelerated or retarded the diameter-growth or thickness of the trees cannot be stated, as observatian was not called to it, but they have certainly increased as much in that respect as the trees around them of the same sort and age. In one instance, the cutting of a limb, where the tree cleft, has had the effect of setting the other stem upright, so that it appears now exactly in the perpendicular line, and like the original stem of the tree.

and into which the roots immediately connected with these boughs penetrate and afterwards keep possession. By taking off such branches early, therefore, the extra supply of nourishment afforded by such local circumstance of soil is directed to the stem and useful lateral branches.

It has been already observed, that, by depriving a tree, to a certain extent, of its side branches, the growth of the stem in length is promoted, but the diameter, strength, or thickness of it is not increased in the same proportion. When the side branches are destroyed by natural causes, or by the neglect of judicious thinning, the like injurious effects ensue to the primary object here in view, that of obtaining the largest quantity of timber of the best quality on a given space of land.

When the lateral branches perish or cease to be produced, except towards the top of the tree, from the want of pure air and of the vital influence of the solar rays on the foliage, the existence of the tree may continue for years, but the produce or increase of timber of any value ceases, and it dies prematurely, affording at last a produce comparatively of no value, after having obstructed the profitable and healthy growth of the adjoining trees during its latter unprofitable stages of life. In the contest for the preservation of existence which takes place after a certain period of growth among the individual trees of a plantation which has been neglected, or left without the aid of judicious pruning or thinning, there will be found trees which, from the accidental circumstance of having originally a vigorous, healthy constitution, and from partially escaping the numerous injuries and obstructions of growth that accrue to trees by neglect of culture, have attained to a valuable timber size. The timber of the few such trees, however, as have thus gained the supremacy, is frequently much blemished by the stumps of the dead branches having become imbedded in the wood; and this serious injury to the quality of the timber and value of the tree, is the invariable consequence of neglecting to prune off these stumps as soon as they appear, or rather neglecting to cut away close to the stem such branches as indicate decay, and before they cease growing.

The time at which pruning should begin, depends entirely on the growth of the young trees. In some instances of favourable soil and quick growth of the plants, branches will be found in the course of four or five years to require foreshortening, and in case of the formation of forked leaders, to be pruned off close to the stem. When the lateral branches of different trees interfere with each other's growth, pruning, so as to foreshorten, should be freely applied in every case, in order to prevent the stagnation of air among the branches, or the undue preponderance of branches on one side of the tree. Perfect culture, in this respect, requires that the plantation should be examined every year, and by keeping the trees thus in perfect order there will never be any danger of making too great an opening, or depriving a tree too suddenly of a large proportion of branches. The operation will also be so much more quickly performed, as to render the expense of management less than if the pruning were delayed, or only performed at intervals of years, as is too frequently practised. By this management there will be little, if any, necessity for pruning close to the stem, until the tree attain to twenty feet in height, or even more than that, provided the stem be clear of lateral branches from five to eight feet from the root. When the lateral branches are regular and moderately large, the smaller length of clear stem may be adopted, and where the branches are larger towards the top, the greater space of close pruning. Five years from the first close pruning will not be too long before the second is performed; one, or at most, two tire of branches

may then be displaced in like manner. The increase of diameter of the stem, is the only certain test for deciding whether the larger or smaller number of branches may be pruned off to most advantage, or whether it may be prudent to take any away from the stem until it attain greater strength and thickness. By examining the trees of a plantation annually, the critical time for pruning every branch for the best interest of the trees is secured. Some trees may be pruned with great advantage successively for years, whilst others may only require it every three or five years, and others again not at all.

It has been disputed whether resinous or non re-productive trees are benefited by pruning; but the value of judicious close pruning to that tribe of trees cannot be doubted: at the same time it is but too true that, in numerous instances, it has been carried to a mischievous excess. Young firs and larch trees, when deprived of their lateral branches, to within four or five tire of shoots of the top, are frequently seriously injured by the winds acting on the tuft of branches, which become as a lever loosening the roots, and producing all the evils of a suddenly checked growth, besides those of excessive bleeding or loss of the resinous sap, and the want of the periodical supply of nourishment to the stem afforded by these branches. At sixteen years of growth, larches standing at four feet apart, will be benefited by moderate pruning; *i. e.*, of two or three tire of the lowermost branches, particularly should these appear to be *decreasing* in their former vigour of growth; and afterwards in every third or fourth year, successively, the like treatment should be adopted to these lowermost branches evincing a decline of healthy growth. The same rule applies to the pine or Scotch fir and the spruce; but the former, having large and compound branches, should be pruned at an earlier age than the latter, or before the lateral shoots are more than two inches in diameter. When the branch to be taken off is several inches in diameter, the wound is so large, the excavation of resinous sap so great, and the heart-wood, or the vessels which constitute it, so indurated, as to render the perfect union of the new and the old wood less certain than in young branches, all which make the removal of large branches productive of more evil than service t the growth of the tree and quality of the timber. On the contrary, when the pruning of the pine is altogether neglected, and the dead or rotten stumps or snags of branches are left to be embedded in the wood, or to form cavities for the accumulation of water or other extraneous matters in the substance of the stem, all the purposes of profit and of pleasure are sacrificed to neglect or unskilful culture.

*Judicious thinning* may be said to be productive of the same valuable effects to a plantation of timber-trees in the aggregate, as those which judicious pruning produces on every individual tree composing it: by the admission of a proper circulation of air and the solar rays, and permitting the free expansion of the essential lateral branches of the trees, as well as by preventing an unnecessary waste or exhaustion of the soil by the roots of all supernumerary trees.

The great advantages of judicious thinning are not confined to the object of obtaining the largest quantity of timber of the best quality on a given space of land in the shortest space of time; but the produce of the trees thus thinned out ought to afford a return sufficient to pay the expenses of culture, interest of capital, and the value of the rent of the land. In many instances the profits arising from the thinnings of well managed woods have covered these charges before the period of twenty years from the time of planting. The time at which the process of thinning should be commenced, depends on the like causes as those which regulate pruning, and need not here be repeated.

In general the freest growing plantations require to have a certain number of trees taken out by the time they have attained to eight years of growth from planting. On forest-tree soils of a medium quality, the age of ten or twelve years may be attained by the young trees before thinning is necessary; but should fifteen years elapse before the trees demand thinning, it will be found that the plantation has been imperfectly formed.

No certain rule can be given to determine the number of trees to be thinned out periodically, which will apply to all plantations and to every kind of forest-tree in them. A well-grounded knowledge of the principles of vegetable physiology, and of the habits of trees, is absolutely essential, to execute with success this very important branch of arboriculture. We may, however, quote the following statement from practice as one example, taken from an average of acres on an extensive plantation in Sussex:

One acre of siliceous sandy soil, worth 7*s.* per acre, when under pasturage, being properly prepared and planted with larch, at three feet and a half apart, required thinning for the first time, when the trees had attained to ten years of growth.

Number of trees when planted 3555 on one acre, of which 100 had failed during the first ten years of growth; therefore when the thinning commenced the number was 3455.

| Number of Years Growth when thinned. | Number of Trees left on each occasion of thinning. | Distance of the Trees. Ft. | In. | Number of Trees thinned out. | *s.* | *d.* | Value. *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 3097 | 3 | 9 | 100 worth | 0 | 4 each. | | | |
| | | | | 200 | 0 | 3 | 4 | 13 | 0 |
| | | | | 58 | 0 | 2 | | | |
| | | | | 100 vacancies from accidents. | | | | | |
| 15 | 2722 | 4 | 0 | 55 | 0 | 10 | | | |
| | | | | 100 | 0 | 6 | 7 | 4 | 2 |
| | | | | 120 | 0 | 4 | | | |
| | | | | 100 | 0 | 1 | | | |
| 20 | 2411 | 4 | 3 | 20 | 1 | 6 | | | |
| | | | | 91 | 1 | 0 | 8 | 17 | 8 |
| | | | | 150 | 0 | 4 | | | |
| | | | | 50 fuel | 6 | 8 | | | |
| 27 | 2073 | 4 | 7 | 20 worth | 2 | 0 | | | |
| | | | | 25 | 1 | 6 | 13 | 14 | 0 |
| | | | | 100 | 1 | 0 | | | |
| | | | | 193 | 0 | 6 | | | |
| 35 | 1440 | 5 | 6 | 25 | 2 | 6 | | | |
| | | | | 100 | 1 | 6 | 32 | 3 | 3 |
| | | | | 275 | 1 | 0 | | | |
| | | | | 233 | 0 | 9 | | | |
| 43 | 1031 | 6 | 6 | 30 worth | 3 | 0 each. | | | |
| | | | | 50 | 2 | 6 | 32 | 4 | 0 |
| | | | | 200 | 1 | 6 | | | |
| | | | | 129 | 1 | 0 | | | |
| 51 | 680 | 8 | 0 | 40 | 3 | 6 | | | |
| | | | | 100 | 2 | 6 | 37 | 11 | 0 |
| | | | | 150 | 2 | 0 | | | |
| | | | | 61 | 1 | 0 | | | |

The future returns of income from the plantation, now rest on six hundred and eighty trees nearly arrived at their perfection of growth. The distance of nine feet apart is considered a sufficient space for the larch,

spruce, and silver firs, to attain to their maximum of timber growth, on soils of an average quality adapted to their habits; and as the above trees may profitably occupy the soil for twenty or thirty years more, or without ceasing to produce timber annually for that period, the thinning now should depend on, or be regulated by, the circumstances of demand for the produce, more than for the benefit of the individual trees which remain.

In the above details of thinning, it will seem to demand an explanation, why certain trees of the lowest value at fifty years' growth should have been left apparently to encumber the ground, while trees of a value equal to these are cut down at ten years' of growth. The answer to this question brings us back again to the difficulties before alluded to, of giving any data, or rules applicable in all cases, founded on number, size, distance and time, for the execution of the different processes of culture, relative to assisting and controlling the functions of vegetable life, so as to produce a given result, or obtain a specified quantity of timber from certain trees under different circumstances of soil, site, local climate, and culture.

If all trees were produced from seed with the same degree of constitutional strength, and were the soils on which they might be planted of the like nature throughout, and under equal circumstances with regard to moisture and exposure, as well as to every other influential point, then statical rules of practice for the culture of trees might with equal certainty be given, and of as general an application to suit every variety of case, as those for the execution of any mechanical art: but the reverse of all this is the fact; and every variation in the soil, and in the exposure and growth of the trees, must be met with a corresponding variation in the process of culture, as regards the number of trees to be thinned out, the distances at which they should stand, and their size and age. The trees above mentioned, which at fifty years' growth were not of greater value for the purposes of timber, than several trees thinned out at ten, assisted the growth of the more valuable trees, which immediately or more remotely adjoined them, by the shelter they afforded against cutting winds, and by ameliorating the local climate, to that degree as to fully warrant their continuance. Those trees which were of equal value to these when cut down at ten years' of growth, stood so close to others of greater promising value as to injure the growth of both, and had they been suffered to remain, would have prevented some of the most valuable trees of the plantation from attaining to perfection. Thus, on the one hand, by removing the former description of plants, the most valuable trees are promoted in growth, and on the other preserved from injury, by suffering less valuable ones to remain.

Various tables have been calculated to assist in deciding on the number of trees to be thinned out of plantations at stated periods; one of these by Mr. Waistell*, appears to be brought to as near a correct average, as the nature of the subject will permit.

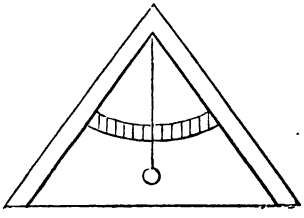
'The following table shews the number of trees to be cut out in thinning woods, and the number left standing at every period of four years, from twenty to sixty-four years, reckoning that the distance of trees from each other should be one-fifth of their height, and that the trees should have increased twelve inches in height, and one inch in circumference annually, and to have been at first planted four feet apart.'

* Transactions of the Society of Arts, vol. xxvi., and Withers's 'Memoir on planting and rearing Forest-trees,' p. 37.

| Years old and feet high. | Girt. | Contents. Ft. | In. | Pts. | Distances. | Number of Trees on an Acre. | Contents of the whole in feet. | Number to be cut out. | Contents. Feet. |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 2½ | 0 | 10 | 5 | 4. | 2722 | 2362 | 839 | 727 |
| 24 | 3 | 1 | 6 | 0 | 4.8 | 1883 | 2824 | 494 | 741 |
| 28 | 3½ | 2 | 4 | 7 | 5.6 | 1389 | 3308 | 326 | 776 |
| 32 | 4 | 3 | 6 | 8 | 6.4 | 1063 | 3779 | 223 | 792 |
| 36 | 4½ | 5 | 0 | 9 | 7.2 | 840 | 4252 | 160 | 810 |
| 40 | 5 | 6 | 11 | 4 | 8. | 680 | 4722 | 118 | 819 |
| 44 | 5½ | 9 | 2 | 11 | 8.8 | 562 | 5194 | 90 | 831 |
| 48 | 6 | 12 | 0 | 0 | 9.6 | 472 | 5664 | 70 | 840 |
| 52 | 6½ | 15 | 3 | 0 | 10.4 | 402 | 6130 | 55 | 838 |
| 56 | 7 | 19 | 0 | 8 | 11.2 | 347 | 6611 | 45 | 857 |
| 60 | 7 | 23 | 5 | 2 | 12. | 302 | 7076 | 37 | 866 |
| 64 | 8 | 28 | 5 | 4 | 12.8 | 265 | 7537 | | |

When there is a deficiency of access to certain parts of the plantation, and additional rides or drives must be made, the lines should be marked out by barking the trees in the course of it, or, what is better, by a circular mark with whitewash or lime. The roots should be grubbed up, and the surface of the ground prepared and sown with the seeds mentioned in Chapter V. When there are steeps or hills, the drives should be formed with the most easy ascent for the convenience of timber carts. The ascent ought not to be greater than one foot in thirty. The most useful instrument for determining the ascent or descent of forest drives, is constructed in the form of the common level, furnished with an index divided into ninety degrees. When the plummet line hangs at the forty-fifth degree, the legs of the instrument indicate a perfect level (*fig.* 10), and when it hangs at a lesser or greater number, it indicates the degree of ascent or descent accordingly. In plantations the thinning of which has been neglected, the trees next the sides of the drives are always the largest and most valuable, and afford a test at all times to judge how far judicious thinning has been practised or neglected. When this essential part of culture has been neglected, the greatest caution is necessary in performing the work. The trees being grown up slender, weak, and deficient of side branches, a too sudden exposure to the winds or currents of air, will be found injurious, if not fatal. The outside trees should be continued in their thicket state for several years after the first relief is given to the interior trees, and even then should only be deprived of decaying companions, or of branches unnecessary for the purposes of shelter, but which it may be advantageous for the trees to lose. Trees weakened by growing in a crowded state, become more obnoxious to disease, and to the attacks of insects, and to that of parasitic plants, such as mosses and lichens, which rarely or never appear on healthy and vigorous trees. The number of trees to be taken out on the first occasion of the thinning of a neglected plantation should be very limited, and confined to those which have become the most exhausted. The process should be carried on for six or seven years, until completed. The pruning of such trees should be confined to the removal of decaying or dead branches, until the gradual introduction of fresh air, and the solar rays by the thinning process has renewed lateral shoots and invigorated the branches*. Forest-trees are, like other organized bodies, confined to a

*Fig.* 10.



* It is a great error to suppose, that by leaving trees in an individually crowded state, the object of a close cover is secured; on the contrary, this object will only be gained for

certain period of existence, in which the stages of growth are distinctly marked, from the first development of the plant in its seedling state, until its ultimate decay by the course of nature. Different species of trees have different periods of existence. The oak is considered to be of the longest duration, and, perhaps, the larch of the shortest. The oaks in Woburn Park, mentioned at page 50, as being of such large dimensions and in perfect health, cannot be supposed to be under three hundred years of age. The elm may be placed next in order with the chestnut, ash, beech, and hornbeam, the pine, and lastly the larch*. These estimates of the comparative duration of different species of trees are, however, given from observation only, and are not founded on such certain data as to render them more than an approximation to the truth; for soils, local climates, and the various other causes which promote or retard the progress of vegetable health and growth, interfere with the completion of the perfect, natural term of vegetable life in numerous instances. Under the most favourable circumstances, however, of soil and culture, trees are subject to various diseases and accidents, and from what has already been mentioned, as to their structure and living functions, this will be no matter of surprise. The diseases of forest-trees may be comprised under those of a general nature, wherein the internal functions are interrupted or partially destroyed; and secondly, those of a local nature arising from external causes, as accidents of various kinds, and the attacks of insects. Neglect of judicious planting and of after culture, are the chief causes of the first mentioned kinds of disease, and tend to aggravate the bad effects of other accidents. When a tree puts forth leaves of paler tint than their natural green colour, and never assumes it again during that and succeeding seasons, and when the growth of the branches is very small and frequently imperceptible, some of them also decaying at the extremities, the disease is termed *chlorosis*. It originates principally from an ungenial subsoil. The effects of confined air by a crowded state of the plantation, or a too sudden exposure to sharp blasts, will also induce this disease. Topical remedies are of no use, and the means of prevention should be used in planting, and in the after culture.

Spontaneous bleeding, or great loss of sap, generally ends in the disease termed *tabes*, which, when once confirmed, is incapable of being cured. The elm is of all forest-trees the most subject to this disease. Whenever the branches become disproportionate to the stem and roots, or the foliage too scanty to receive and elaborate the periodical flow of sap, spontaneous bleeding takes place. The neglected stumps of dead branches having formed cavities, afford ready outlets to the sap. Branches which have been suffered to grow too large in proportion to the rest of the tree, and are bent down or project in an horizontal direction from the stem, are frequently attacked with *hæmorrhagy*, which, according to our observation and experience, never heals, but continues periodically until the death of the tree. The fluid which is thus discharged by the elm, appears to differ in no respect from the ascending sap of the plant, affording extractive and mucilaginous matters, combined with potassa and lime; the solid matter deposited by the fluid in its course of descent over the bark, leaves a whitish tract at first, but in time becomes blackened by the weather, smoke, &c. The track thus marked out by the hæmorrhage, will point out the wound with certainty and readiness. Grass and herbage on which this fluid drops

a few years at first, or until the trees interfere with each other's healthy growth, and begin to contend for existence. By judicious pruning and thinning, or by keeping any individual tree in its most perfect healthy state, a perpetual cover will be obtained, as complete as the species of tree and the nature of the soil will admit.

* The Pinus Lambertia before mentioned, found on the north-west coast of America, was estimated of nine hundred years' growth, although sound in the timber.

is destroyed by it. When there is made a strong effort of the functions of the plant to heal up the wound, and, after it is almost wholly closed with healthy bark, a substance of a dark colour and resinous appearance is exuded. This substance is termed *ulmin;* as a pigment it produces the most beautiful brown, and appears to consist of a peculiar extractive matter and potassa*. The oak, under the like circumstances, exudes a substance having similar external characters. The birch and maple, when cut or lacerated through the bark into the wood, suffer much from the loss of sap which flows from such wounds.

The pine and fir tribe of trees have a resinous juice, which exudes freely from wounds of the bark. When large branches are injudiciously pruned off, the injury is considerable from the waste of sap. In the cases of full-grown trees of the elm being affected with this disease, the best course is to take them down for timber; but where it is desirable to preserve the tree for landscape or ornamental effect, the decayed stumps should be cut away close to the sound bark, and the wound dressed carefully to protect it from the weather. If a cavity exists out of which the sap has, for a considerable period, been in the habit of exuding, the aperture should be cleared of the dead bark covering its sides, and then the mouth should be securely closed by the composition before recommended, or by any other substance that may be found more effectual to prevent the admission of rain, and of air. Whatever tends to increase the number of healthy branches and leaves on the tree, will the most effectually restrain the disease.

*Tabes*, or the wasting of trees, is brought on not unfrequently by parasitical plants, as ivy, covering the cutis of the barks, and preventing the healthy functions of that organ. The loss of the green colour of the leaves, the gradual wasting of the branches, and diminution of the foliage, indicate the confirmation of the disease. If taken in time the remedy of cutting the ivy at the root is speedy and effectual. When lichens pervade not only the stems but the branches of trees, the functions of the bark are disturbed, and disease ensues. On damp soils, where proper thinning is neglected, lichens and mosses propagate to the extremities of the branches, and flourish in a surprising degree. Caustic lime water thrown upon the parasites will destroy them without injuring the tree, provided it be done during the fall of the leaf. A hand-engine will apply the lime water to a great many trees in the course of one day. The necessity of topical applications, however, of this sort for forest-trees, ought to be avoided by timely thinning and pruning, thereby admitting a circulation of pure air, and the solar rays into the interior of the plantation, which check the propagation and growth of parasites.

The number of different species of insects which infest forest-trees is very great; they are all productive of more or less injury to the growth of the plants. The most destructive are:—

| | | | Time they appear. |
|---|---|---|---|
| **Noctua pinastri*, Lin. | *xylena, Hüb.* | pine moth | June. |
| *fimbria* | oak moth | . | August. |
| *pyramidea* | copper underwing | oaks | ,, |
| *macilenta* | brickmoth | elms | ,, |
| *citrago* | sallow moth | limes | ,, |
| *alniaria* | canary-shouldered moth | limes | ,, |
| *erosaria* | . . . | limes | September. |
| *olivaria* | green carpet moth | birch | August. |
| *betulitana* | . . . | . | ,, |

* Agricultural Chemistry, p. 105. Ulmin is elsewhere stated to be an acid *sui generis*, and, like other vegetable acids, to be a compound of carbon, hydrogen, and oxygen—that it combines with potassa like an acid, and is again precipitated from it by acids having a stronger affinity for potassa.

| | | | |
|---|---|---|---|
| *Noctua rapezana* | diamond-back moth | . | August |
| *iciana* | white backed | willow | ,, |
| *upsilon* | dismal moth | . | ,, |
| *retusa* | double kidney moth | . | ,, |
| *nupta* | red underwing | . | ,, |
| **Scolytus destructor* | bark beetle | oak and elm | March. |
| **Lasiocampa quercus* | egger moth | oak | July. |
| *crataegi* | hawthorn moth | white thorn | ,, |
| **Coccus lariceo* | larch scale | larch | ,, |
| *abietis* | spruce fir bug | fir | ,, |
| *aceris* | maple bug | maple | ,, |
| *alni* | alder bug | alder | ,, |
| *betulæ* | birch bug | birch | ,, |
| *quercus* | oak bug, | oaks | June, July. |
| *salicis* | willow bug | willows | June, July. |
| *tiliæ* | lime bug | limes | June, July. |
| *carpini* | hornbeam bug | hornbeams | June, July. |
| *capreæ* | crack willow bug | salix caprea | June, July. |
| *oxycanthæ* | thorn fly | white thorn | ,, |
| *Aphis ulmi* | elm fly | elm | June, Aug. |
| *quercus* | oak fly | oaks | ,, |
| *pini* | pine fly | pines | ,, |
| *tiliæ* | lime fly | limes | ,, |
| *fraxini* | ash fly | ash-tree | ,, |
| *betulæ* | birch fly | birch-tree | ,, |
| *fagi* | beech fly | beech-tree | ,, |
| *aln* | alder fly | alders | ,, |
| *salicis* | willow fly | willows | ,, |
| *bursaria* | black poplar fly | black poplar | ,, |
| *aceris platanoides* | maple fly | maples | ,, |
| *Cynips quercus folii* | gall fly | oak | ,, |

The pine moth nestles in the leading bud of the pine, and destroys its principal shoot. The attack of this insect often injures a whole plantation, as they propagate fast, and prefer the terminal bud of the stem. If on the first appearance of the insect, or before it had affected more than two or three trees, means were immediately had recourse to for destroying them, and guarding every season to prevent them from establishing themselves in numbers, the prevention of their ravages would be thus effected at a moderate cost of labour or expense.

The *scolytus destructor* is a formidable insect. It penetrates through the bark into the alburnum, on which it feeds, destroying the organization of the bark, and annihilating its functions. In time the bark separates in large masses from the wood, and the tree dies. The elm is most obnoxious to this insect *. The pine is also subject to attacks of the same kind, and attended with the like fatal effects.

* It has been supposed to be the effect of disease rather than the cause of it, or of living on the dead and decaying juices; but when we never find the insect in life on a dead tree, but always on a living one, and that oftentimes in the full vigour of health, we cannot conclude otherwise than that the *scolytus destructor*, if not the only cause of *tabes* or a wasting of the plant, is one of the primary ones, and is never an effect. Very recently a number of elm trees, of a considerable age and size, in the neighbourhood of Camberwell, died in a very rapid manner. The bark became detached from the stem, and fell off in large pieces, or could with small force be removed by the fingers for a space of five feet from the root upwards.

The bark was perforated by the scolytus in numerous instances, and their ravages on the alburnum were evident by crowded tracks through its substance. There were a very few of the trees which escaped destruction; but even these had perforations of the bark,

The larva of the *lasiocampa quercus* sometimes strip the leaves entirely of the branches of the oak. When the trees are young, and the attack is perceived before it has made great progress, the application of caustic lime water, served by the hand-engine before mentioned, is the only topical application we have found practicable, as regards cost, time, and effectiveness.

The different species of coccus or scale-like insects which infest most trees, seldom attain to such numbers as to endanger seriously the health of forest-trees.

The aphis or fly is more common and injurious. Almost every distinct species of tree has a species of aphis peculiar to itself. The glutinous substance which, in hot arid weather, appears so general on the upper surface of the leaves of trees, is produced by these insects. This substance, by attracting other insects, and by arresting smoke and dust on the surface of the leaves, prevents the leaves from performing their healthy functions. For large trees and extensive plantations topical remedies are of course out of the question. In confined cases a solution of soft soap, or of water impregnated with caustic lime and sulphur, are either of them very effectual cures.

The gall fly (*cynips quercus folii*) deposits its eggs in the membrane of the leaves of the oak, and produces those tumours on the leaves called oak galls. The extent of injury inflicted on the general health of the tree has never been observed to be great, or such as to warrant any expensive trial for a cure.

The last disease, or rather defect, that may be mentioned here, is termed *shake*, and should be carefully guarded against in the culture of forest-trees. Trees, though outwardly to all appearance sound in the stem, are often found with splits of several feet in height from the root upwards. This is frequently caused by strongly bending the stem of a tree from the top when young. The stem of trees in plantations which have been neglected in judicious thinning and pruning, being tall and slender in proportion to the branches of the top, these act as a lever to the wind, and in time produce this blemish in the timber. In carrying out

although in smaller number. Before the bark began to peel off, gas pipes had been laid near the foot of one row of the elms, the time had been only about six weeks, and the mischief was imputed to the escape of the gas among the roots. This reason, however, was untenable, inasmuch as trees removed to a considerable distance from the gas pipes were equally affected; while a few already mentioned adjoining it escaped. Besides, the foliage shewed no signs of being affected, which all gaseous poisons have the immediate effect of shewing first on the leaves. In this instance the state of the trees, previous to the introduction of the gas pipes near to the roots, showed that the *scolytus destructor* had been one of the several causes that produced the death of the trees. These elms were in rows, and formed an avenue. They had been planted too close in the rows, and had also been neglected in thinning and pruning. The remains of dead stumps, and the numerous cavities left by others, marked out by the discoloured traces on the bark of the long existence of an yearly hæmorrhage of sap, and also the scanty tops in proportion to the size of the stems, all proved that the disease *tabes* had been confirmed. Add to this the bad effects of drains, and deep foundations cut out in the immediate neighbourhood of the trees, accompanied by two excessively dry seasons (1825 and 1826) so favourable for the propagation of the *scolytus destructor*, and the crisis and results of the disease will not be any subject of wonder. A tree of the *pinus pinaster*, which had been reared in a pot, was subjected to the influence of gas the same as that supplied to the roots of the elm, but without producing any perceptible effect. A large ox bladder was filled by the writer of this with the carburetted hydrogen gas, and connected by a pipe with the draining aperture of the pot, in which the roots of the pine were confined. This quantity of gas was made to pass through the earth in the pot during the space of forty-eight hours, and renewed and continued for three weeks; but, as just now observed, without producing any ill effects on the health of the plant. The pine is liable to be injured and destroyed by the insects before mentioned, in the same manner as the elm.

the produce of the thinning of a plantation, as well as in executing the work in a careless manner, the same bad effects are not unfrequently produced in young saplings. The decay which is observed at the lower end of the stems of larch trees, when planted on chalk, or on very damp clay, is clearly the fault of the subsoil, and sometimes appears when the tree is only eighteen years old. In numerous instances we have found it commence at the seventh year's annual layer of wood, and never earlier, and to extend to the thirty-fifth year's layer, but not beyond that growth. In all our observations it appeared to be either within seven and thirty, or thirty and thirty-five years' layers. The fungus, which appears in the defective wood, commences at the higher portion of the main branch of the root connected with the annual layer affected, and proceeds upwards. Its characters are extremely similar to those of the *dry rot* (*merulius destructens*), so much so, that until more minute observation determine to the contrary, they must be considered identical. It is highly probable, therefore, that the *dry rot* exists in the interior of timber, while the tree is yet growing, although possibly in too inert a state to be distinguished by the naked eye. In the living plant no remedy has yet been discovered for this disease. Judicious planting will ensure prevention by furnishing each distinct variety of soil and subsoil with those species of forest-trees only which are best adapted to them; and this principle, whether in the herbaceous plants of husbandry, in fruit trees in gardening, or in timber trees in forest planting, is never violated with impunity. Various means have been tried, from time to time, to prevent the appearance of dry rot in timber, as well as to arrest its progress when once begun. The first of these objects is supposed to be gained by *seasoning* the timber previously to using it. Some recommend the bark to be taken off the tree to a certain height a year before it is felled, and the practice has been tried long ago on the oak *, and more recently with the larch. It would appear, however, in the latter case, that when the trees are young, the alburnum or sap wood becomes soft rather than hard under the process.

Another mode of seasoning timber is by immersing the trees in water for a period of one or more years. This practice is considered very beneficial, but it is clear that the necessary proofs cannot be obtained under a period of many years comparative trials of seasoned and unseasoned wood in the same building, and under the same circumstances in the building. The seasoning of wood by subjecting it to a strong heat by means of steam has also been tried, but, as in the former case, time is required to determine its efficacy. When wood is left to the process of nature to become seasoned, the desired effects are more perfectly produced by protecting the wood from rain and sun. Knowles, in his Essay on Dry Rot, recommends the timber to be 'kept in air neither very dry nor very moist; and to protect it from the sun and rain by a roof raised sufficiently high over it, so as to prevent by this, and other means, a rapid rush of air.' Confined air and a moist temperature encourage the propagation and growth of the *merulius destructens* in a high degree. When unseasoned wood is painted, the latent seeds of the dry rot are thereby encouraged and assisted in vegetating and spreading the fungus or algæ with destructive rapidity.

The proper season for cutting down timber-trees is that in which the sap is most quiescent, *viz.*, midwinter and midsummer; but particularly the

* In 1737 Buffon disbarked three oak-trees, forty feet in height, where they stood, and they remained in that state for three years; they were then cut down, and the results were found to be in favour of the practice.

former. Trees whose bark is valuable require to be felled before the complete expansion of the leaf. From the middle of April to the end of June is the proper time for the oak; the larch should be peeled earlier. The birch having a tough outer cuticle of no use to the tanner, and as this is more easily separated from the proper bark after the sap has partially circulated in the leaves, it is generally left standing until the other species of trees are felled and barked.

The process of barking is, in general, well understood. The harvesting of the bark is of the greatest importance, for if it be suffered to heat or ferment, it loses its colour, becomes mouldy and of little value. The best mode is to make what the foresters term temporary lofts of about two feet in width, and of a length sufficient to hold a day's peeling of bark. These lofts are formed by driving forked stakes into the ground for bearers, about three feet in height in the back row, and two and a half feet in the front; a sloping floor is then constructed by laying loppings between the forks of the bearers. The bark is then placed on the sloping floor with the thick ends towards the top or higher side, the smaller bark is laid on to the depth of six or ten inches, and the broad pieces placed over the whole as a covering to carry off the wet, should rain happen before the bark is sufficiently dry to be stacked. In three or four days it should be turned to prevent heating or moulding, and in ten days, more or less, it will be sufficiently dry to be stacked until wanted for the tanner. In order to prevent fermenting when stacked, the width of the pile should not exceed eight feet. The roof should be formed and thatched as a corn or hay stack. In preparing the bark when ready for the tanner, it is cut into pieces about three inches in length, and weighed. It is sold by weight.

The quantity of tannin contained in the bark of different forest-trees has been ascertained by Sir Humphry Davy, and although the proportion of tannin afforded by the bark varies according as the spring may be favourable in temperature, the following numbers will be found to express nearly their relative values, if the larch cut in autumn be excepted:—

| | |
|---|---|
| Average of entire bark of middle-sized oak, cut in spring | 29 |
| of Spanish chestnut | 21 |
| of Leicester willow, large size | 33 |
| of elm | 13 |
| of common willow, large | 11 |
| of ash | 16 |
| of beech | 10 |
| of horse-chestnut | 9 |
| of sycamore | 11 |
| of Lombardy poplar | 15 |
| of birch | 8 |
| of hazel | 14 |
| of black thorn | 16 |
| of coppice oak | 32 |
| of oak cut in autumn | 21 |
| of larch cut in autumn | 8 |
| white interior cortical layers of oak bark | 72* |

In general the bark of the larch is not worth more than half the price of oak bark, and the proportion given to larch in the above table may, therefore, be considered too small. The great disproportion between the produce of tannin afforded by the inner bark and that of outer layers, shews with what care the harvesting of the bark should be performed to prevent

* Agricultural Chemistry, p. 79.

fermentation, which destroys the tannin principle first in that portion of the bark containing it in the largest quantity.

The weight of bark afforded by given contents of timber, varies according to circumstances connected with the growth of particular trees, as whether grown in confined air, or in healthy, open situations, also as regards the age of the trees. The statements given by Mr. Monteith, in his 'Planter's Guide,' are, perhaps, as near to the truth of an average as the nature of the subject will admit, at least they are consonant with the results of our own practical experience.

| | Every cubic foot of timber affords of bark | | |
|---|---|---|---|
| | lbs. | | lbs. |
| An oak 40 years old . . | from 9 | to | 12 |
| Ditto from 80 to 100 ditto . | „ 10 | „ | 16 |
| Larch timber, per foot . . | „ 8 | „ | 10 |
| Birch timber, large ditto . . | „ 11 | „ | 14 |
| Willow, ditto . . . | „ 9 | „ | 11 |

The most judicious mode of felling forest-trees is by grubbing up, or taking the solid part of the root with the bole, in every case where coppice stools are not wanted, for the expense of taking up the roots afterwards when either planting or tillage may be demanded on the sites of the felled trees, will be found to exceed that of taking up the root with the stem in the first instance, besides the injury to the immediate fertility of the soil by the introduction of fungi and insects, the first agents generally of decomposition of the roots of felled trees which do not stole or reproduce shoots. Besides the advantages now alluded to, there is another, that of the value of the solid part of the roots of trees. The peculiar structure of many roots afford the best materials for what is termed ornamental rustic work; and also the compact texture of the wood, and the diversified lines of the medullary rays and concentric circles, fit it for the manufacture of very interesting cabinet works.

The root of the larch affords a valuable material for forming knees of boats. Admiral Fleming was the first, we believe, to point out this property of the larch. The lower part of the stem, with the solid root attached, is quartered, and, when joined, form knees of a lasting nature,—that part of the wood, the solid root produced under ground, and always in contact with damp, being probably more adapted to withstand the effects of moisture than the proper wood produced in the open air.

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## Chapter VII.

*Of the progressive increase of size or produce of wood in different species of forest-trees. Of the mode of valuing plantations—present value—prospective value of certain individual trees which have attained to great maturity. Of the products of plantations, and of the terms used by foresters to denote these products.*

It is a common observation, that the slower a tree grows the harder is its wood. This statement, as applicable to trees of different species or genera, as, for instance, between the poplar and the oak, is generally correct, but between individual trees of the same species, two oaks, for example, the observation will be found not to apply; indeed the reverse will be found proved if we examine into the facts which bear directly on the point. In every plantation we find that the individual trees composing it vary considerably in what is termed quick or slow growth,

and that in all plantations where the pruning and thinning have not been judiciously executed, the trees which stand on the outside of the plantation, or on the sides of the drives, are larger, say double the size, or have been of much quicker growth than those in the interior of the plantation. Now the greatest comparative degree of strength and hardness of the woods of the two trees is proved to be in that of the larger, or the tree whose growth was most rapid and vigorous—the sap wood being of course larger in the fast-growing tree, as are all the annual layers of the heart wood. If the reader will look back to page 8, where the structure of the wood of different species of trees is described and figured, it will be seen that the wood of the oak, a comparatively slow-growing tree, is distinguished from the wood of the poplar, a fast-growing tree, by having the cellular structure comparatively confined to the concentric circles which mark the annual increase of wood; that the number of cells between these concentric circles are few, though of a larger diameter, while in the wood of the poplar they are dispersed in great number, or crowd the whole surface of a section of the wood. If the hard wood of the locust (*fig. n*, p. 10) be compared to the soft wood of the fir (*fig. o*), to the laburnum (*fig. q*), the lime (*fig. p*, p. 11), sweet chestnut (*fig. e*), to the horse-chestnut (*fig. h*), and every hard and durable wood to the soft and non-lasting kinds, the same clear and marked distinction will be evident, *i. e.* the hard, tough, and durable woods have the cells chiefly confined to the annual rings, or thinly scattered in irregular groups, leaving comparatively wide intervals of apparently solid fibre, while all the soft or non-lasting woods have the entire substance pervaded with minuter cells, in number and regularity that may be compared to the texture of fine lace or net work.

These then are the external discriminating characters of hard and of soft woods; and let us now apply these to distinguish the woods of fast and of slow growing trees of the *same species*, and we find that the wood of the fast-growing tree has wider intervals between the concentric circles, or congeries of cells, or, in a word, fewer cells to the size or diameter of the wood, and is consequently wood of greater strength, toughness, and durability. The experiments of Professor Barlow on the strength of different woods confirm the above conclusions*. The opinion of Thomas

* Mr. Withers, in his Letter to Sir H. Stewart, p. 115, states, that he received from Mr. Boorne, of Erpingham, a respectable timber-merchant, two specimens of oak, one taken from a fast, and the other from a slow growing tree. No. 1. was grown upon a very *strong good soil*, the age of the tree about sixty years, and it contained from thirty-eight to forty feet of timber. No. 2 was about one hundred and twenty years old, and was grown upon a light soil, with gravel about two feet below the surface. These specimens being submitted to Professor Barlow, of the Royal Academy, Woolwich, were tried, and gave the following results:—

| Specific gravity. | Deflected one-fiftieth of its length with | Broken with | Comparative strength. |
|---|---|---|---|
| | No. 1. | | |
| 903 | 660lbs. | 999lbs. | 1561. |
| | No. 2. | | |
| 856 | 414lbs. | 677lbs. | 1058lbs. |

No. 1, it appears, is, therefore, of about medium strength, my mean number being for English oak, 1470.

No. 2 is very weak, my weakest specimen being 1205. (See Essay on Strength of Timber.)

Mr. S. Farrow, timber-merchant, Diss, Norfolk, states to Mr. Withers, that 'It has always been a custom with me when I wanted a mild, tender piece of oak for any purpose, to look out for a slow-growing tree to cut it out of; and, on the contrary, when hard wood was wanted, to take the fast-growing tree, one which, before being felled, was in full and rapid growth, and I have ever found the latter much the most durable wood.' Two specimens of oak communicated by Mr. Farrow, No. 1, of a tree reared close to the rick-yard of the farm, and by the side of a ditch into which ran a great deal of moisture from the yard.

Andrew Knight, F.R.S., on this important subject is, that the toughest and most durable oak timber is obtained from trees of vigorous, rapid growth. The property of quick growth, in some species of trees, however, is confined to their earlier stages; in others it is not developed until they have stood several years in the soil, and in several the rate of annual increase of wood continues steady comparatively until the trees attain full maturity.

The locust-tree (*Robinia pseudo-acacia*), for instance, will outstrip the oak in the first ten years of their growth by a rate of increase at least double that of the latter, but afterwards the oak will gain upon the locust,

This tree grew rapidly, and, contained, when taken down, one hundred and sixty cubic feet of timber. The tree from which No. 2 was cut grew in the same field, and believed to have been planted at the same time. This tree grew well, but not in any degree so fast as the other, and contained about ninety cubic feet of timber. The age of the trees was estimated at one hundred and twenty years growth. These specimens were forwarded by Mr. Withers to Professor Barlow, for examination as to their comparative strength, and the following interesting results were obtained:—

No. 1.—Fast Grown Oak, Manured.

| Specific gravity. | Weight when deflected the piece 1-50th of its length. | Broken with | Comparative strength. |
|---|---|---|---|
| 972 | 606lbs. | 999lbs. | 1561lbs. |

No. 2.—Slow Grown Oak, Natural Soil.

| | | | |
|---|---|---|---|
| 835 | 439lbs. | 943lbs. | 1473. |

The strength of the fast-grown oak timber is, therefore, in this instance, superior to that of slower growth, as 15 to 14 nearly.

On these facts Mr. Withers observes, that 'the tree, which had no support but the natural soil, produced ninety feet of timber in one hundred and twenty years; the other, whose roots were continually nourished by manure, made one hundred and sixty feet in the same period, being a difference of seventy feet. The manured tree made, on an average, one foot one-third of timber in each year. Estimating, therefore, according to that rate of increase, this tree was, fifty years ago, of equal size, and of greater value, to the unmanured tree at the time it was cut down. Now, if we reckon the value of the timber at only 8*l.* a load, and allow compound interest for the fifty years, the difference of value between the manured and unmanured tree amounts to upwards of 165*l.* This,' continues Mr. Withers, 'is the amount of profit arising upon one tree; let a calculation, founded upon such data, be applied to the millions of acres which might be covered with forest-trees; and then let land-owners and statesmen reflect, whether *our own country* does not afford ample and profitable employment for all the "surplus agricultural labourers."' The cost of trenching and manuring, according to Mr. Withers' own experience, is stated to be as follows:—

Planted in April, 1824.

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| Twenty loads of marl, at 1*s.* 3*d.* | 1 | 5 | 0 |
| Twenty ditto muck, at 5*s.* | 5 | 0 | 0 |
| Ploughing land | 1 | 10 | 0 |
| Trees, carriage, and planting | 7 | 10 | 0 |
| Total cost per acre | 15 | 5 | 0 |

The results afforded to Mr. Withers by the above preparation of the soil, and by subsequent culture of the surface of the soil, were such as to be perfectly conclusive in favour of trenching and manuring to *holing* in unprepared soils. Now making every reasonable deduction for the uncertainty of the two oaks last alluded to having been reared under the same circumstances in every particular, which influences and governs the growth and progress to perfection of forest trees, (as already mentioned in Chapter II.,) except that of the supply of liquid manure to the tree No. 1, and making a similar deduction for the uncertainty of obtaining manure, and also that of the comparative rate of increase of timber between trees planted in the mode Mr. Withers recommends, or by the cheaper mode of holing, after the first twenty or thirty years of their growth, there are evidently advantages left sufficient to warrant the adoption of this mode of planting all soils of the nature mentioned at p. 39, whether on private estates or in the royal forests. In either case a certain sum can only be afforded, and it is then to be considered whether that sum had better be employed on a limited space of land annually, by which a speedier return of profit will be obtained, and the ultimate object, that of a stronger and more valuable quality of timber reared to perfection in a shorter period of time, or by covering a larger space of land with plants which will give inferior returns in a much longer extended period of growth.

and its rate of progress will continue superior. The silver fir increases comparatively at a much inferior rate to the larch and other fast-growing trees, for ten or more years, but in general it passes all these trees in height and in circumference by the thirtieth or fortieth years of its growth.

The comparative rate of increase annually of the following forest-trees is, in the average of cases, nearly in the following order:

| | | | |
|---|---|---|---|
| Poplar, | for the first | 50 | years of growth. |
| Bedford willow | do. | 25 | ditto. |
| Birch | do. | 20 | ditto. |
| Larch | do. | 60 | ditto. |
| Sycamore | do. | 50 | ditto. |
| Pine | do. | 60 | ditto. |
| Silver fir, | after the first | 30 | ditto. |
| Alder | do. | 25 | ditto. |
| Locust | do. | 15 | ditto. |

Trees of slower growth, but more equal in the rate of annual increase throughout their progress, are

Elm, ash, beech, sweet chestnut, oak.

On comparing a variety of measurements made of different trees on the same soil, and also of these in soils of different natures, the increase of the oak to that of the larch, at sixty-five years of growth, proved to be as 6 to 3.6 nearly. The silver fir stood to these in the proportions of 8 to 6 and of 8 to 3.6 *.

When a tree has attained to full maturity, or to as large a size as the nature of the soil and situation are capable of inducing, the annual production of shoots from the extremities of the top branches is scarcely perceptible. When these begin to decay, and the tree gives indications of soon becoming what is called *stag headed*, the profitable increase of timber has ceased in that tree, and it no longer occupies the ground profitably. The most profitable stage of growth, however, at which a tree may be taken, must be determined by the state of the market and the demand for particular produce. The only certain rule is, to ascertain the annual increase of timber in the tree, and determine thereby whether the value of that increase be equal to the annual interest of the sum the tree would bring, if felled, in addition to the charges of the land it occupies.

The following statement of the increase of trees at seventeen years of growth in the climate of Devonshire, on a porous soil, prepared by trenching, and planted in the most judicious manner, according to instructions by the Duke of Bedford, will show the comparative value of different species of forest-trees, as regards their property of affording early produce on a soil of the nature mentioned.

| | Girt or Circumference at Two Feet from the Root. In. | Girt or Circumference at Seven Feet from the Root. In. |
|---|---|---|
| Popla | 41 | 37 |
| Larch | 37 | 32¼ |
| Pine | 32¼ | 25¼ |
| English elm | 32 | 26 |
| Silver fir | 28¼ | 25 |
| Spruce | 27 | 22 |
| Chestnut | 27 | 22 |

* Well-authenticated facts relative to the comparative rate of increase of wood in the different species of forest-trees are much wanted. Without such facts, ascertained by careful and minute consideration of all circumstances influencing the growth of the trees, as soil, local climate, age, and culture, unerring or scientific principles cannot be obtained to guide the practical planter.

| | Girt or Circumference at Two Feet from the Root. In. | Girt or Circumference at Seven Feet from the Root. In. |
|---|---|---|
| Birch | 25 | 20 |
| Sycamore | 24 | 20 |
| Beech | 23 | 21 |
| Oak | 23 | 13 |
| Ash | 20 | 17 |

The heights of the trees were in full proportion to the girth, and the measurements are an average of the dimensions of six trees of each of the species respectively; there were numerous instances of individual trees exceeding any of the above in girth and length *.

Comparing the above with the former order of the rate of annual increase, the silver fir is found to be much lower in the rate of early produce in the first instance, but the genial climate in which the trees mentioned in the latter statement were cultivated will readily account for the discrepancy. In the higher grounds of Blair Adam before referred to, the silver fir is of slower growth than any of the trees mentioned in its early stages, but after that overtops them to a considerable height. The sweet chestnut, in the soil and local climate which thus rear the silver fir ultimately to such a high superiority, stands at the lowest point on the scale, while, in the more southern latitude and lower elevation, the chestnut takes precedence of the birch, sycamore, beech, oak, and ash. Local circumstances connected with soil, climate, and culture interfere with the idea of drawing general conclusions from these facts to be considered as data to guide the practical planter in every case; but to the valuer of plantations, which have only reached to their first stages of growth, these facts are of more extensive application, as showing the importance of estimating justly the effects of these agents in the progressive or annual rate of produce of timber in different species of forest trees.

The present value of a plantation is that which the market will afford for its produce at the time the valuation is made.

Prospective value is that to which the trees will attain at a remote period, or that to which they may arrive at full maturity, according to their respective species, and best fit the purposes for which they are most esteemed.

When a plantation is only of a few years growth, the value of the produce is too insignificant to be estimated, and the growth of the trees is often then so undeterminate as to render it difficult to calculate the ultimate results in this case; and when property is to be transferred, the cost of planting and the rent of the land occupied, with the sum of compound interest on the amount of these, must be taken as a just valuation.

When trees have reached to eight years of growth, their value is so small as to be below estimating; they will, however, by this time afford certain evidences on which to found calculations of their ultimate produce and value. Until trees have attained to a full timber size, the valuation of a plantation ought to proceed on the principle of prospective value. This includes, first, the number of years the trees will require to arrive at full maturity; secondly, the marketable value of the trees when at that perfection of growth; thirdly, the value of the periodical thinnings and of underwood. From the total amount of these sums must be deducted compound interest for the period the trees require to attain maturity; the remainder will represent the present transferable value of the plantation.

Thus on three and a quarter statute acres of a sandy soil, worth from five to twelve shillings per acre per annum when under pasturage, larch had

* Communicated by Mr. John Forester, at Endsleigh, Devonshire, from the Duke of Bedford's plantations.

been planted in 1810, and in 1826 it was desired to ascertain the prospective value of the plantation for 1851 *.

The trees amounted to 3311, of which 1000 were fit for fuel only, and required to be removed for the benefit of the healthy trees. The periodical thinnings being estimated every five years, this plantation would afford in

| | Trees. | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| 1831, thinnings | 600 worth | 0 | 10 | each . | 25 | 0 | 0 |
| 1836, | 560 | 1 | 6 | . . | 42 | 0 | 0 |
| 1841, | 504 | 2 | 6 | . . | 63 | 0 | 0 |
| 1846, | 212 | 6 | 0 | . . | 63 | 12 | 0 |
| Underwood cut at three periods, including 1000 stunted trees, fit only for fuel | | | | . . | 6 | 0 | 0 |
| | | | | | 119 | 12 | 0 |

*Timber Trees standing in* 1851.

| | | | | | | |
|---|---|---|---|---|---|---|
| Largest sized trees 68, containing, on an average, each 30 feet of timber, at 1*s.* per foot . | | | . | 102 | 0 | 0 |
| Second size | 238 worth 10*s.* 0*d.* | . | . | 119 | 0 | 0 |
| Third size | 129 do. 6*s.* 3*d.* | . | . | 40 | 0 | 0 |
| Total value of periodical thinnings, and of standing timber in 1851 . . . | | | | 380 | 12 | 0 |

*Deductions.*

Deductions for present payment.

| | £. | s. | | | £. | s. | d. |
|---|---|---|---|---|---|---|---|
| Discount on | 3 | 0 | value of cuttings in | 9 years | 1 | 1 | 4 |
| Ditto | 3 | 0 | ditto | 9 | 1 | 1 | 4 |
| Ditto | 25 | 0 | for thinnings in | 5 | 5 | 8 | 3 |
| Ditto | 42 | 0 | ditto | 10 | 16 | 4 | 4 |
| Ditto | 63 | 0 | ditto | 15 | 32 | 14 | 0 |
| Ditto | 63 | 12 | ditto | 20 | 39 | 16 | 8 |
| | | | | | 96 | 5 | 11 |

| | | | |
|---|---|---|---|
| Therefore prospective value as before . . | 380 | 12 | 0 |
| Deductions as above . . . | 96 | 5 | 11 |
| Present or transferable value of the above plantation | 284 | 6 | 1 |

From these details it will appear that an intimate knowledge of the habits of growth of the different species of forest-trees, and of the influence of soil and local climate on their periodical increase of timber, is absolutely required in the business of valuing plantations prospectively.

In settlements and divisions of landed property an accurate knowledge of the prospective value of all the plantations under full grown timber on the estates, is doubtless of great importance. The question of the comparative advantages and disadvantages of the occupation of land by forest-trees, and by corn and herbage, is one about which there has been much difference of opinion. There are those who contend that the former is

* The plantation in question formed a part of an extensive wood. From various causes, as the attacks of vermin, and the neglect of judicious culture, in suffering the natural produce of the soil to injure the young trees, and allowing trees of a more vigorous growth to injure those of a weaker, and partly also, from many of the plants having had an originally weak constitution, the failures had been considerable, but where the trees had escaped the effects of these evils, they had made good progress, and afforded evidence of future value as above detailed.

most advantageous, and others again argue, that for every purpose of private and public advantage, the latter is immeasurably superior. The truth lies between; for the fact is, neither of the two can profitably exist without the aid of the other, and the question becomes then narrowed to that of the proportions in which each should stand to the other. This point, however, has already been discussed as far as the limits of these pages permit, and it may be further only necessary to add, that the produce of timber in the United Kingdoms is very far from being sufficient to meet the demand for it. From a report of a select committee of the House of Lords, relative to the timber trade, made in 1820, it appears that the average quantity of foreign timber and deals imported into Great Britain during the four preceding years, amounted to 322,069 loads; the duty alone on which, in the last year of that average, 1819, amounted to 1,019,311*l.* 18*s.* 1½*d.* The statements of extraordinary profits from woodlands must be considered rather of a local than of a general interest; that of Lord Barham's chestnut plantation in Kent, which at nine years growth afforded a produce for hop-poles, which sold for 104*l.* per acre; a plantation of larch, for the same purpose, but on a soil not worth more than from 6*s.* to 7*s.* per acre, for cultivation, produced at the rate of 91*l.* per acre*. Of the willow, oak, &c. numerous instances of the like great profits might be adduced.

As a general estimate of the profits arising from forest-planting may not be uninteresting, the opinions of three professional planters of considerable experience on the subject are here mentioned.

Mr. Pontey of Huddersfield, the author of several esteemed treatises on planting, states, that from careful calculations of what might be reasonably expected from an acre of land suitable in itself, tolerably favourably situated, and in every respect well managed as a plantation of larch, the result is, a net profit—after paying for the rent of the land and every ordinary expense—of much nearer five than four hundred pounds in forty-two years.

Mr. Monteath, the well known author of the *Planter's Guide*, estimates the entire cost of planting, after the establishment of a nursery, at 22*s.* to 30*s.* per acre, with that of enclosing in large clusters, at about 10*s.* The periodical returns from an acre of larch only, after payment of the expenses of cutting, he calculates at from 5*l.* to 7*l.* at the expiration of the first ten years;

| | | | |
|---|---|---|---|
| at least | £25 | ditto | second ditto. |
| | £300 | at forty years growth. | |

And assuming the average rent and annual charges on an acre of light sand adapted to the growth of larch to be 12*s.*, the amount of profit and loss will stand as follows:

| | £. | s. | d. |
|---|---|---|---|
| Enclosing and planting | 2 | 0 | 0 |
| Compound interest at five per cent. during ten years | 1 | 12 | 6 |
| Charges at 12*s.* per annum, with compound interest at five per cent. for ten years | 7 | 11 | 0 |
| | 11 | 3 | 6 |
| Deduct the medium value of the first thinnings; *i. e.* 5 to 7 | 6 | 0 | 0 |
| Balance | 5 | 3 | 6 |

* Kent Report, p. 146.

| | £. | s. | d. |
|---|---|---|---|
| Compound interest, at five per cent. on balance for ten years . . . . . | 3 | 4 | 6 |
| Annual charges, with compound interest during ditto . . . . . | 7 | 11 | 0 |
| | 15 | 19 | 0 |
| Value of thinnings at twenty years growth . | 25 | 0 | 0 |
| Profit per acre | 9 | 1 | 0 |

Thus, according to this estimate, doubling the capital, with compound interest, in twenty years, besides leaving timber standing on the ground, which in twenty years more is calculated to be worth 300*l.*

Mr. George Sinclair, F.L.S., calculates, that the thinnings on an acre of land, of the value of from 5*s.* to 10*s.* per acre, planted with a mixed proportion of larch, beech, pines, hazel, birch, and oak—the latter with a view to the growth of navy timber, will, at the end of ten or fifteen years, according to local circumstances, repay the average expense of planting, rent, and management during that period, together with compound interest at five per cent.; and he estimates the clear profits of the future falls as follows:

| | | | | |
|---|---|---|---|---|
| In thirteen years, or at twenty-three years growth | £24 | 10 | 0 | per acre. |
| In thirteen years, or at thirty-six years growth | 39 | 0 | 0 | do. |

And after that period a triennial profit of about 12*l.* per acre, until the oak left standing may be supposed fit for the naval yards, and worth at the present prices, 264*l.*, which leaves a balance superior in the proportion of 300 to 7 to the fee simple of the land*. But let it be remembered, that these calculations are all founded on the supposition of judicious planting and subsequent culture.

M. Chaptal† estimates the forests or woodlands of France to occupy about sixteen millions nine hundred and four thousand acres, or about one-seventh of the whole productive land of that kingdom. According to M. Herbin de Halle, there are of forest lands belonging to

| | Acres. |
|---|---|
| The State . . . | 2,802,652 |
| Crown . . . | 164,565 |
| Princes of the Royal Family . | 479,348 |
| Public Bodies . . | 4,834,284 |
| Private Individuals . . | 8,623,555 |

The produce is estimated at five millions three hundred and forty-seven thousand pounds sterling, or about from six shillings and fourpence to seven shillings and fourpence per acre. Compared to this of woodland, the production of arable land is estimated at ten shillings, and grass land is placed on a level with that under the vine, *viz.* thirty-three shillings and eightpence an acre‡.

* These calculations were made at the same time by the three individuals mentioned, but unknown to each other; and as the results agree in all material points, except as regards the cost of planting in the second statement, which is very low, the general conclusion receives much weight.—*Prospectus of British Forest Planting*, 1826.

† *Journal des Forêts, tome premier. A Paris*, 1829.

‡ 'Les *prés* sont placés sur la même ligne, malgré le proverbe populaire qui dit que la vigne rachéte le pré.'—*Ibid.*

The royal forests of Britain occupy about 125,000 acres of land *; but of these the greater portion are subject to claims of various sorts for common of pasture, turbary, &c. There are 32,768 acres of forest-land enclosed and planted principally with oak, and with other trees where the soil is not adapted to oak. Of these 13,700 acres may be laid open when

* A Return, showing the number of acres in each of the Royal Forests, distinguishing the open commonable lands, and the lands appropriated to the growth of timber, in each forest; also, the number of acres of other lands, the property of the Crown, appropriated to the like purpose.

| Name of the Forest. | Contents. | Open commonable Lands. | Lands appropriated for the growth of Timber. | Remarks. |
|---|---|---|---|---|
| | Acres. | Acres. | Acres. | |
| New Forest, in the county of Southampton | 66,678 | 60,678 | 6,000 | Subject to rights of common, the inclosed lands to be thrown open when the trees are past danger of deer or cattle, when an equal quantity may be inclosed out of the waste in lieu of what shall be restored to common. |
| Dean Forest, in the county of Gloucester | 21,473 | 10,473 | 11,000 | |
| Woolmer Forest, in the county of Southampton | 5,949 | 4,249 | 1,700 | |
| Waltham Forest, in the county of Essex | 3,278 | 3,278 | | Subject to rights of common. |
| Alice Holt Forest, in the county of Southampton | 1,892 | | 1,892 | The property of the Crown in fee. |
| Bere Forest, in the same county | 1,417 | | 1,417 | |
| Salcey Forest, in the county of Northampton | 1,285 | | 1,285 | |
| Windsor Forest, in the county of Berks | 4,402 | | 4,402 | |
| Delamere Forest, in the county of Chester | 4,641 | | 4,641 | |
| Parkhurst Forest, in the county of Southampton | 900 | | 900 | |
| Whittlewood Forest, in the county of Northampton | 4,500 | 1,122 | 3,378 | 517 *a.* 3 *r.* 31 *p.*, the property of the Crown in fee remainder, subject to rights of common; the inclosed lands in this and in Whichwood Forest consist partly of coppices, which are by law thrown open to deer and cattle at the end of 7 or 9 years from the time when first inclosed, and at which period the young trees are not past danger of deer and cattle, and are, in consequence, in a great measure, destroyed. |
| Whichwood Forest, in the county of Oxford | 3,709 | 1,808 | 1,841 | Subject to rights of common. |
| *Other Lands appropriated for the growth of Navy Timber.* | | | | |
| Freehold lands in New Forest, in the county of Southampton | | | 974 | |
| Do. in and adjoining Dean Forest, in the county of Gloucester | | | 3,708 | |
| Do. do. Woolmer Forest, in the county of Southampton | | | 183 | |
| Do. do. Bere Forest, in the same county | | | 132 | |
| Woodlands at Eltham, Gillingham, &c. in the county of Kent | | | 1,000 | |
| Parcels of the Crown Estate at Chopwell, in the county of Durham | | | 896 | |
| Uninclosed Lands, arising partly from inclosures thrown open, and partly from woods of spontaneous growth, which are so stocked with trees as to be reckoned in the quantity of productive timber, estimated at about | | | 7,500 | |
| Lands now appropriated for the growth of Timber | | | 52,850 | |

An

the trees are past danger of deer or cattle; and an equal number of acres to those thus laid open, may be enclosed and planted. The remaining 14,068 acres belong to the crown in fee, and will always be kept enclosed. There are 6211 acres of other freehold land belonging to the crown, which are also appropriated to the growth of timber, making in all 38,979 acres, the whole of which have been enclosed and planted within the last twenty years. In New and Dean forests, Hainault forest, Whittlewood forest, and Wychwood forest, there are open woods or coppices of considerable extent, containing trees of all descriptions, from ship timber down to saplings; but the number of acres so covered, or the number of trees occupying the surface, appear to be unknown.

The soil of the royal forests of Britain contain almost every variety of soil,—deep strong clay, rich deep loam, light loam on freestone gravel, bog, &c. The quantities of these different soils should be estimated. It is quite true that a field of ten acres may contain two or three different varieties of soil; but that is no substantial reason for not classifying the quantities on which to found a practical plan of management, so as to obtain the largest and speediest return of produce of the best quality, and that every portion of the land be occupied to the best advantage. Without an estimate of the spaces of the different soils, no accurate calculation can possibly be made of the produce the lands in question ought to and would afford under the most judicious culture; and consequently there is no check whatever to the practical management, but that of vague opinion.

As the most judicious, because the most profitable and certain in the result of obtaining the largest quantity of timber of the best quality in the shortest space of time, on a given space of land, the preparation of the soil for the reception of the plants by paring and burning the surface, afterwards trenching, and manuring when possible, and taking from the soil thus prepared an ameliorating fallow crop the season before planting, has been urged at pages 22, 27, and 39, as a general principle of culture for the soils of the nature specified. But if this mode of culture be therefore so superior as it is proved to be for planting lands under ordinary freehold tenure, how much more beneficial, or rather essential, must the adoption of it be in cases such as of those belonging to the crown, where the rights of common render it imperative to open the fences of the young plantations to stock or to sheep and deer in seven or nine years from the period of planting. The trees so cultivated will in that period be comparatively out of danger, and the ultimate object, that of timber of the best quality the soil is capable of rearing, secured. But besides these advantages, that of affording profitable employment to labourers out of work, in the parishes adjoining the lands in question, and at a season of the year when labour is most scarce, cannot but add powerfully to the reasons, sufficient of themselves, already offered on this head; besides the valuable example for imitation by the public which the Government would, in this important branch of rural economy, afford, and by it encourage those

An account of the quantity of land, cultivated and waste, in the British Dominions, including Scotland and Ireland, and the British Isles, according to the evidence of Mr. William Cowling, before the Emigration Committee, in 1827.

| | Cultivated acres. | Uncultivated acres. | Unprofitable acres. | Total. |
|---|---|---|---|---|
| England . . . | 25,632,000 | 3,451,000 | 3,256,400 | 32,342,400 |
| Wales . . . | 3,117,300 | 530,000 | 1,105,000 | 4,752,000 |
| Scotland . . . | 5,265,000 | 5,950,000 | 8,523,930 | 19,738,930 |
| Ireland . . . | 12,125,280 | 4,900,000 | 2,416,664 | 19,441,944 |
| British Islands . | 383,690 | 166,000 | 569,469 | 1,119,159 |
| | 46,522,970 | 15,000,000 | 15,871,463 | 77,394,433 |

who may possess waste or unproductive land to plant it, for a present benefit to the unemployed labourer, and as an accumulating capital for the younger branches of his family and posterity, as well as for the general good of his country.

The following statements will shew that the cost of preparing the different soils of the nature and properties described at pages 48, 49, and 50 of this Essay, and numbered 3, 4, 5, 6, for planting forest-trees in the best manner, that is to say, by paring and burning the coarse surface, trenching, draining, and manuring when expedient, and afterwards taking a green fallow, or ameliorating esculent crop as a precursor to the forest-tree plants, will be repaid by a judicious choice and culture of the kind of crop best adapted to the soil, and the produce of which is in a greater local request. It may be perhaps unnecessary to observe here, that the nature of different varieties of soil, comprehending their texture, chemical properties, the nature of the subsoil or mineral stratum on which they are incumbent, and their local climate and site, have all a great and active influence in determining the probable cost of the culture of the crops best adapted to be raised or cultivated upon them.

The local demand for the produce of particular species of husbandry crops have also a considerable influence on the comparative marketable value of these crops: hence it is impracticable to make a perfectly clear comparative estimate of value of different crops in the present case applicable to every different soil, unless those different circumstances alluded to under which each is placed were accurately known; but which, under ordinary circumstances, may be readily ascertained in the locality. The potato, Swedish turnip, cabbage, carrots, mangel worzel, khol rabi, tares, or vetches, &c., have each a superior local value, according to circumstances, besides that of their absolute or intrinsic value generally, as crops in husbandry. We may take the first-mentioned crop, therefore, as an example, its culture, comparative value as a fallow-crop, and the marketable value of its produce being, perhaps, more generally understood than that of the others. The soil is, taken of a second-rate quality, worth a rent of from fifteen to twenty shillings per acre.

| | £. | s. | d. | | | |
|---|---|---|---|---|---|---|
| Paring and burning . . | 1 | 16 | 0 | | | |
| Trenching . . . | 4 | 0 | 0 | | | |
| Draining or grubbing up . | 0 | 15 | 0 | | | |
| Potato sets or seed, 16 bushels at 1*s.* 6*d.* . . | 1 | 4 | 0 | | | |
| Planting, ditto . . . | 0 | 16 | 0 | | | |
| Hoeing and earthing up . | 0 | 16 | 0 | | | |
| Reaping . . . | 1 | 10 | 0 | | | |
| | | | | £10 | 17 | 0 |
| Produce | | | | | | |
| 6 tons of potatoes from a virgin soil, prepared by paring, burning, and trenching, at 44*s* . . | | | | 13 | 4 | 0 |
| Balance remaining . . . . | | | | 2 | 7 | 0 |

after preparing the soil in the best manner for planting, to go towards paying the purchase of plants and planting, as in the case of lands belonging to the crown, or, in other cases, towards the charges of rent, interest of capital laid out in fencing, payment of tithes, taxes, and other public imposts.

The above mode of preparing the soil would afford seventy-three days work an acre to labourers, at two shillings a day, chiefly in that portion of the year when labour is least in demand, viz., from the middle of September until April. Were fifty acres set apart every year on an average from each of the royal forests, and planted according to the plan now recommended, there being twelve royal forests situated in the counties of Southampton, Gloucester, Essex, Northampton, Berks, Chester, Oxford, Durham, and Kent, labour or work alike profitable to the unemployed and to the country would thus be given to six hundred men in the parishes and neighbourhood in which such lands are situated. The profitable results, as regards the attainment of the principal object in view, viz., timber of the best quality the soils employed are capable of affording, and that in the largest quantity on a given space of land, and in the shortest period of time, have already been discussed and shewn to follow the mode of culture described.

There is stated to be but one-sixteenth part of the timber used at the royal yards supplied by the extensive forests of the crown, the other fifteen-sixteenths having to be purchased from private estates, and from abroad. There is good reason to believe the planting and rearing of oak and of hard wood in general have not kept pace in England with the consumption of that article. The policy of depending on foreign countries for an article of such paramount importance as that of timber for naval and civil architecture, need not be discussed in these pages. But let us consider, however, whether the forests abroad are always to remain unexhausted for our demands, or the supply of our wants herein, while the neglect of planting continues;—we believe not; and that other countries will, at no very distant period, be in the condition that the North American states now are, as regards the supply of timber from their natural forests. That condition is described by an accurate observer, A. H. Hillhouse, a citizen of the United States, and the translator of Michaux's 'North American Sylva.' His words are, 'Though three-fourths of our soil (North America) are still veiled from the eye of day by primeval forests, the best materials for building are nearly exhausted. With all the projected improvements in our internal navigation, whence shall we procure supplies of timber fifty years hence for the continuance of our marine? The most urgent motives call imperiously upon government to provide a seasonable remedy for the evil: from a government like ours, which is a faithful expression of the public will, and which has no concern but the prosperity and honour of the nation, and from which prospective wisdom is reasonably demanded.'

It is observed by Mr. Loudon, in his Encyclopædia of Gardening, that in planting, as in every other branch of culture, extraordinary profit is attended by extraordinary production, which soon sinks the market value of the article; and also, that in a commercial, free, and highly taxed country, whenever any article attains a very high price, substitutes are found at home, or imported from abroad, so that no particular crop should be considered the best to cultivate without exception, nor extraordinary profits calculated prospectively on any crop whatever.

This opinion, however just, as applied to annual or biennial crops, is but slightly applicable to forest planting, and, indeed, not at all as regards the planting of waste or inferior soils, because, as before stated, the value of a crop of timber or of a forest plantation depends not alone on the relative or positive worth of the timber itself, as is the case with the kinds of crops alluded to, but also greatly on the circumstances of improving the climate and the soil of the adjoining lands, fitting them for the growth of

the more valuable husbandry crops, and the rearing and fattening of the more valuable domestic animals, which, without the aids that judicious forest-planting confers, would be withheld, and the land continue waste and unprofitable to the owner and to the nation.

The high perfection to which some individual trees of the different species have attained, is an object of much interest to the profitable planter of forest-trees as well as to all; for who does not derive pleasure of the highest order from the contemplation of woodland scenery? The limits of these pages admit but of a few short notices on this point.

The oak which was felled in April, 1791, in the park of Sir John Rushout, Bart., at Northwich, in Worcestershire, and judged to be about three hundred years old, and perfectly sound and fine timber, measured

| | Feet. |
|---|---|
| In circumference, or girt, at five feet from the ground . | 21 |
| Smallest girt . . . . . | 18 |
| Length to the branches . . . . | 30 |
| Solid contents of the body . . . . | 634 |
| Estimated timber in the arms . . . . | 200 |
| Cubic feet of timber . . | 834 |

The celebrated Fairlop oak, in Hainault Forest, Essex, is stated to have measured at three feet from the ground about thirty-six feet in circumference, and the extremities of the branches gave a circle of three hundred feet.

In Welbeck Park an oak is mentioned as one hundred and eleven feet in height, seventy feet up to the branches, and the circumference at the bottom twenty-one feet.

In Holt Forest, near Farnham, an oak in 1759 girted thirty-four feet at seven feet from the ground; in 1778, or in nineteen years, it had increased only half an inch.

At Oakley, in Bedfordshire, the seat of the Marquis of Tavistock, there is an oak now in perfect health, which contains about five hundred and twenty-seven cubic feet of timber, and the branches overspread a space of five thousand eight hundred and fifty superficial feet of ground.

Mr. Rookes, in his account of the oaks of Welbeck, mentions that an oak cut down in Birchland, had the letters I. R. more than a foot within the tree, and about a foot from the centre. It was supposed to be two hundred and ninety-two years old. It was perfectly sound, and measured about twelve feet in circumference.

The oaks in Woburn Park have already been alluded to as being trees of remarkably fine growth. There is one situated in the park, to the east of the Abbey, which measures ninety feet in height, the main stem of which is fifty feet, and head above the forks forty feet. This tree contains four hundred and ninety-two cubic feet of timber. The circumference at four feet from the ground is fifteen feet two inches.

There is another fine oak, in perfect health, which contains six hundred and sixty-six cubic feet of timber, on the west of the Abbey. The circumference near the ground is thirty feet, and the height to the boughs sixty-six feet. Four of these oaks measures two thousand and sixty-eight cubic feet of timber, after deducting one-eighth, the allowance for the bark. The variety of oak in this park is chiefly of that called the foot-stalked oak, *Quercus robur pedunculata.*

The elm may be placed next to the oak for utility and ornament. The wych elm is the most hardy. There is one mentioned by Evelyn in Sir Walter Bagot's Park, in Staffordshire, which measured forty yards in

length, and at the stool seventeen feet in diameter. The weight was estimated at ninety-seven tons.

The chestnut (Castanea vesca) may dispute the order of precedence with the elm, but that it is less hardy, and requires a milder climate, and more genial soil. On the banks of the Tamar, in Cornwall, there are some of the finest specimens of this tree. A very remarkable tree of this kind in England is at Tortworth, in Gloucestershire. A figure of it is given in the Gentleman's Magazine for 1766, p. 321. The age of this tree is supposed to be upwards of one thousand years. In 1791 it measured forty-four feet four inches in circumference. The soil in which it grows is described as being a soft loamy clay.

The finest tree on record of the beech appears to be that in Woburn Park, situated on a rising ground south of the Abbey, in a fine grove of that species of tree. The height of the tree at this period is one hundred feet. It has a clear and nearly equally cylindrical stem of the height of fifty feet, and the top, which is of the most graceful proportion in every respect, occupies fifty feet in height. The solid contents are four hundred feet. The soil in which this remarkable tree grows has already been described at p. 48.

Of the larch (Pinus larix), the finest specimens have been produced in the extensive woods of the Duke of Athol, at Dunkeld, in Perthshire. One tree of fifty years of age measured eighty-six feet and a half in height, and contained eighty-two feet of solid wood. There are instances of the larch attaining to upwards of one hundred feet in height, and of twelve feet in circumference.

The specimens of the silver fir (Pinus picea) at Blair Adam before mentioned are remarkable for size and symmetry; but the finest specimen, perhaps, in Britain grows in Woburn Park. The height of this tree is one hundred and ten feet, and the circumference at four feet from the ground, ten feet six inches; the solid contents or cubic feet of timber contained in it being three hundred and seventy-five feet. The age of the tree is about one hundred and ten years, and the average increase of height has, therefore, been exactly one foot every year, and the periodical produce of timber upwards of three, or nearly three and a half, cubic feet per annum. This appears to be the largest periodical increase of timber, continued for so many years, that is recorded.

Three black Italian poplars, planted by the present Duke of Bedford in 1806, are now of twenty-three years growth, and measure as follows:—

| | | Feet. | Inches. | Solid Contents. |
|---|---|---|---|---|
| No. 1. | Height | 31 | 0 | 60 feet. |
| | Circumference or girth | 6 | 7 | |
| | The stem at fifteen feet ¼ girt, | | 19¾ in. | |
| | Ditto at sixteen feet above ¼, | | 13¼ in. | |
| No. 2. | Lost its top in a blast in 1828. | | | |
| | Measures—Height | 23 | 0 | 45 feet. |
| | One-fourth girt | 16¾ | 0 | |
| No. 3. | Height | 26 | 0 | 46 feet. |
| | One-fourth girt | 0 | 16 | |

These trees were planted on a light soil, but well prepared by trenching.

*The products of plantations* have already been incidentally mentioned. The terms used by practical men to denote these products are not the same in all places, but frequently the same term is used in different counties to mean different products, and sometimes a term used in one place is totally unknown in another. As in legal instruments, relative to the transfer or holding of woodlands, the misunderstanding of these terms has

not unfrequently been the cause of serious inconvenience, it may be of use, therefore, to enumerate these names and synonyma.

*Butt-end.*—That portion of the stem of a tree which is situated nearest to the root.

*Bush*, in gardening and planting, applies exclusively to every perennial ligneous plant (mostly with several stems from its root), which in its natural state seldom attains to a timber size, *e.g.* having a stem *girting* six inches. We understand currant-bush, gooseberry-bush, rose-bush, holly-bush, laurel-bush, &c., but never oak, elm, or ash-bush, &c. The limits between a shrub or bush and a tree cannot be more precisely defined than by the girt or diameter of the stem, under ordinary circumstances of culture, never attaining to, or exceeding the above dimensions.

*Bavins.*—House-faggots, bound with two withers or weefs, chiefly used by bakers for the oven.

*Binders.*—Long pliant shoots of hazel, ash, &c., which have pliancy and length enough for binding down newly-plashed hedges, making close fences round rabbit-warrens, sheep-folds, hurdles, and binding faggots.

*Bole.*—The stem, trunk, or body of a tree, after it has attained to upwards of eight inches in diameter, or to that size which constitutes timber. Vide *Timber.*

*Cane, Smart-hoops.*—Shoots of the hazel, six feet in length; they are cleft for hoops, and are used by sugar-refiners for their earthen pots; also for salmon kits, small tubs, and other purposes of the cooper.

*Cion, scion.*—Properly a shoot one or two years old, or a cutting of a branch of that age for the purpose of grafting. Used sometimes to denote the shoots of a coppice stool. (Worlidge.)

*Coopers' ware.*—The lower ends of ash poles cut from six to eighteen feet long, according to the length of the shoot. They are cleft for the use of the cooper, waggon-tilts, &c.

*Dead woods.*—The same as *kiln-faggots*, which see.

*Edders, Roders.*—The same as *binders*, which see.

*House-faggots.*—The long branches of the hop and fence poles. The tops of hedge-stakes, coopers' ware, &c., bound with one *wither* or *wef.* Vide *Bavins.*

*Kiln-faggots.*—The lowest product of a plantation, being made of the brushings of the wood previous to the commencement of cutting the copse, and are made of brambles, dead-wood in the stubs, and refuse of plants on the surface of the ground; used for burning lime, bricks, &c.

*Girt, girth*, of the *bole*—Is sometimes understood as the circumference of the stem, but more generally as the fourth part of the circumference or side of the square of the stem. Gilpin (in 'Forest Scenery,' vol. i. p. 59 and p. 141) uses it in the former sense, when he says, 'at Wimly, near Hitchin Priory, Herts, a chestnut-tree, in 1789, girted somewhat more than fourteen yards.' He could not mean the tree to square forty-two feet in the side. Grose also appears to use the term *girt* in the same sense, when speaking of the limb of a chestnut-tree at Fortworth, in Gloucestershire:—'One limb measured twenty-eight feet and a half in girt, five feet above the crown.'—*Philosophical Account*, p. 176. Of the same tree he says the stem 'girted fifty-one feet at six feet from the ground.' And Professor Martin quotes from an inscription placed under an etching of it, stating that 'the tree measures nineteen yards in *circumference*,' which sufficiently proves 'the sense in which the word 'girt' is understood by the above. The word girt is doubtless derived from girth, *quasi*, to gird or encompass, notwithstanding its general acceptation is to denote the fourth part only of the circumference, or side of the stem when squared.

*Log.*—The trunk or body of a timber-tree prepared for the sawyer.

*Maiden-plant.*—A young tree raised from seed, in opposition to one produced from an old root or stub.

*Moot*, in Devonshire, is the same with stool in other counties. Vide *Stool.*

*Nascent stem.*—The development of the stem of a seedling plant, just previous to the exhibition of the first leaves.

*Poles.*—Shoots from coppice-stools on the stems of young trees of various lengths, according to the purpose for which they are wanted; those for hops should be from ten to eighteen feet long.

*Red-hearted.*—A discoloration of the central point or heart-wood of a tree, most frequently arising from bad management in the early culture of the tree, by neglecting to prevent or remove every cause of *stunting* the growth in the earliest stages of culture. An ungenial soil produces this defect likewise.

*Sapling.*—A young tree under six inches diameter at four feet from the ground; in some places it is used to denote a young tree raised immediately from the seed, which is then termed a maiden-tree; in others it is considered a young tree, the produce of a coppice-stool, old root, or stub, and, by a few, a long young tree, the produce of either.

*Sears, or low faggots.*—Made similar to bavins (which see), but longer, and generally bound with three withs: used for sheltering farm-yards, hovels, and for various other purposes.

*Fall cutting.*—A term used to denote the period of cutting a copse, which varies from twelve to eighteen and thirty years, according to the soil or produce of the coppice, and the judgment of the proprietor.

*Shaky—shakes.*—The fissures, cracks, or longitudinal openings often found in the timber of trees which have suffered from injudicious culture and an ungenial soil, vide p. 73.

*Shoot.*—Indifferently used for the young, lateral branch of a stem, or that of a coppice-stool or stub.

*Sprig of wood.*—In some instances understood as the branches of a tree. Vide *act.*

*Standard.*—The shoots of a coppice stool, selected from those cut down as underwood to remain for large poles or timber-trees.

*Slivery.*—Small, straight shoots of large ash, &c., cleft into hoops for the purposes of the cooper. Vide *Cane and Coopers' ware.*

*Stem.*—The body of a tree in all its stages of growth, from a seedling to that of a full-grown tree. See *Bole.*

*Stole.*—The first stage of growth of a shoot emitted or sent out from the sides of a root or stub or coppice-stool. See *Tiller.*

*Stool.*—The root of a tree which has been left in the ground, the produce of another tree, or shoot for saplings, underwood, &c.

*Stub.*—See *Stool.*

*Sucker.*—Properly the young plants sent up by creeping-rooted trees, as in the poplar, elm, &c. These suckers are oftentimes very troublesome, under the circumstance of their often appearing in lawns, or grass fields near a mansion. The term sucker is also applied in some places, to denote the side shoots from a stool or stub. See *Stool.*

*Tap-root.*—The first root produced by the seed of a tree, which descends at first perpendicularly into the earth, and supports the plant until the proper leaves are produced, which, in their turn, assist in the production of fibres or proper roots.

*Tellow.*—See *Tiller.*

*Tielar.*—See *Tiller.*

*Tilar.*—See *Tiller.*

*Tiller*, or *Tellar*, a shoot selected for its superior strength and healthy habit from those produced by a coppice-stool to stand for a timber-tree, or for maiden bark, if an oak, to stand for the space of two or three falls.

*Timber.*—When the wood of a stem or branch of any species of plant attains to the dimensions of 24 inches in circumference, or upwards of eight inches in diameter, it is termed *timber*. Those plants whose wood never, or but seldom, attains to the size now mentioned, come under the denomination of shrubs or bushes, poles, &c. Hence the popular distinction between *tree* and *shrub* or *bush*.

Here it may be proper to state the usual mode of determining the quantity of timber in trees. The customary method of measuring timber is by *girting* the piece in the middle, *i.e.* from the *butt-end* or root to the top, where it terminates, at 24 inches in circumference. The mean between these two points affords the nearest average of the circumference or diameter. The fourth of this circumference, squared and multiplied by the length, gives the contents. Thus suppose a stem or bole measures $75\frac{4}{10}$ inches in circumference, or 24 inches in diameter, and 15 feet in length: *then* $75\frac{4}{10} \div 4 = 18\frac{8}{10} \times 18\frac{8}{10} = 2$ft. 5.5 × length 15ft. = 36ft. 9.3 in. But by taking $\frac{1}{5}$ of the circumference and twice the length, the result is more accurate, thus—$75\frac{4}{10} \div 5 = 15$; then 15 × 15 × 30ft. = 46ft. 10.6. But it need hardly be remarked that neither the fourth nor the fifth of the circumference can be used to determine accurately the cubic contents, although in common practice the first is considered sufficiently so. The nearest approach to the truth of the contents is to multiply the square of the circumference of the stem by its length, and that multiplied by .07958 will give the number representing the solid contents, thus—$75\frac{4}{10}$ × .079574 × 15ft. = 47 1.5. Or square the diameter thus,—24 × 24 × .7854 × 15 = 47 1.5. But whatever mode of measurement and calculation be adopted, an allowance must be made for the thickness of the bark. Different species of trees differ much in this respect, and the age of individuals of the same species differ likewise, according to the age of the tree. It is customary in the oak, elm, and trees having a rough bark, to deduct at the rate of one inch for every foot of quarter girt, that is, if the circumference is four feet, the quarter girt is one foot or 12 inches, and the allowance for the bark will reduce it to 11 inches. Less than one foot quarter girt down to six inches, the allowance is made at the same rate, and so for any increase above the example quoted. In ash, and other trees having a thin bark, the allowance is half an inch for every foot of quarter girt. In Scotland, according to Mr. Monteath, the rule is to allow for bark two inches in circumference from 12 to 24 inches; three inches in a circumference of from 24 to 36; from 36 to 48, four inches; from 48 to 72, five inches, and above 72 inches in circumference, to deduct six inches.

*Trunk.*—The body or stem of a forest-tree. See *Bole.*

*Withers* or *weefs.*—The pliant shoots of hazel, ash, willow, &c., for binding the spray and prunings of trees into faggots, brooms, &c. See *Binders.*

## Chapter VIII.

### *Enumeration of the different species of Forest Trees.*

In the following list the trees are arranged in the order in which they are supposed to stand in natural alliance with each other; but being a selection from the whole vegetable kingdom as regards one property, only that of producing timber in the climate of Great Britain, there will be found therefore great breaches in the natural connexion between many of the individuals comprising a list so formed; and on this account, and the want of space, as well as that the Linnean botanical descriptions are equally efficient in distinguishing one family of plants from every other, and different species of plants from each other, the Linnean descriptions only are given.

### MAGNOLIACEÆ.

*Polyandria Poly. Linn.*

| Eng. Name. | Bot. Name. |
|---|---|
| Cucumber-tree or Magnólia. | Magnólia. |

Generic Character—*Calyx*, three-leaved; *petals*, nine; *capsule*, two-valved, imbricated; *seed*, berry, pendulous.

*Time of sowing seed*—as soon as it can be procured from abroad. Sow in pots filled with a mixture of loam and peat, and plunge them into an old hot-bed of tanner's bark. They may also be propagated by layers.

*Uses*—Veneering, the purposes of the turner, and those of timber in general for in-door works.

*Species for Ornament, Shelter, or Underwood.*

| MAGNOLIA. | CUCUMBER-TREE. | Native of | Ft. |
|---|---|---|---|
| Umbrella-leaved | *tripétala* | N. Amer. | 30 |
| Bluish flowered | *acumináta* | —— | 25 |
| Heart-leaved | *cordáta* | —— | — |
| Great flowered | *grandiflora.* | —— | 60-70 |
| Long-leaved cucumber-tree | *auriculata* | —— | 20 |
| Large-leaved | *macrophýlla* | —— | 30 |

*Magnólia grandiflóra.* Big laurel and large magnolia of America, and laurier tulipier of the French, is first seen in North Carolina, near the river Nuse, in the latitude of 35° 31′; and proceeding from this point, it is found in the maritime parts of the southern States and of the Floridas, and as far up the Mississippi as Natcher, 300 miles above New Orleans, which embraces an extent of 2000 miles. According to Michaux, the *magnólia grandiflóra* claims a place among the largest trees of the United States, as it sometimes reaches ninety feet in height and two or three in diameter, but its ordinary stature is from sixty to seventy feet. Its trunk is described as being commonly straight, and its súmmit nearly in the shape of a regular pyramid. The same author observes, that they who have seen this tree in its native soil, blooming with its large white fragrant flowers disposed amidst the rich foliage of the tree, agree in considering it one of the most beautiful productions of the vegetable kingdom. In Carolina it blossoms in May, and the seeds are ripe about the beginning of October. The wood is soft, and remarkable for its whiteness, which it preserves even after being seasoned; it is said to be easily wrought, and not subject to warp, but that it is not durable when exposed to the weather; for this reason the boards of the *magnólia grandiflóra* are used only in joinery in the interior of buildings. In its native climate it grows only in cool shady places, where the soil is composed of brown mould, and is loose, deep, and fertile. The seeds preserve their vegetative powers several months out of the ground. A single tree sometimes yields four hundred cones, each of which contains from 40 to 50 seeds. The most northern point which this tree passes the winter in the open air, is about Nantes, in lat. 47° 13′, but it begins to bear ripe fruit about Grenoble, in lat. 45°. In a garden near Philadelphia, Michæux saw a tree of this species, which bore uninjured the rigorous climate of this part of Pennsylvania, which is much more severe than that of Paris or London. In England the *magnólia grandiflóra* is more injured by being

planted in an ungenial soil than from the severity of the climate. The fact is, the soil should be that above described, but not an insulated portion, as is mostly the case in practice, by digging a hole and supplying it to the plant merely to that extent, whereas it should be general over a large extent of surface, so as to effect the atmosphere by its peculiar exhalations, thus acting on the leaves as well as on the roots. The *magnolia grandiflora* was introduced into England about 1731.

*Magnólia gláuca.*—This tree is found common in Lower Jersey, but is also found in latitude 45° 50′, near Cape Anne, in Massachussets, N. America. In the Carolinas and in Georgia it does not ordinarily exceed twenty or thirty feet, although it sometimes attains to forty feet in height. At New York it yields fruit at the height of five or six feet. The wood is not considered to be of any value in building. The flowers are flagrant, and the bark of the roots has an aromatic odour and a bitter taste. The country people in Lower Jersey drink an infusion of this bark in brandy as a remedy in rheumatic affections, and an infusion of the cones in whiskey is regarded by them also as a preventive against autumnal fevers. (Michaux, 11.) This tree appears to have been introduced into England in 1688.

*Magnólia acumináta* is common in all parts of the United States of America, where it is generally known under the name of the cucumber-tree. Its stature is similar to the magnolia grandiflora, rising to sixty or seventy feet, and sometimes even as high as ninety feet. It is found as far north as the 43rd degree of north latitude, near the celebrated cataract of the Niagara river. The inhabitants of the countries bordering on the Alleghanies gather the cones about midsummer, when they are half ripe, and steep them in whiskey; a glass or two of this liquor, which is extremely bitter, is a preservative against autumnal fevers: on this Michaux remarks, that though he does not deny the efficacy, the remedy has not been made sufficiently evident to induce any physician to attempt its verification. In its native soil, Michaux describes the trunk as perfectly straight, of an uniform size, and often destitute of branches for two-thirds of its length, the summit ample, and regularly shaped; the flowers are five to six inches diameter, of a bluish white, having a feeble odour, but as they are so large and are numerous, they have a fine effect in the midst of the super-foliage. The wood is soft, and like that of the poplar, is fine grained, and susceptible of a brilliant polish, but it is neither strong nor durable when exposed to the weather. In England this tree is perfectly hardy, and attains to a considerable size. Introduced into England in 1736.

*Magnólia cordáta*, heart-leaved cucumber-tree, in its native soil of the banks of the river Savannah in Upper Georgia, and those of the streams which traverse the back parts of South Carolina, attains to forty and fifty feet in height, and from twelve to fifteen inches in diameter. The leaves are from five to six inches in length, and from three to five in width; the flowers, which appear in April, are yellow, and are nearly four inches in diameter. The wood is of no determinate use, but the tree is very hardy and ornamental in parks. Introduced into England in 1801.

*Magnólia tripétala*, umbrella-tree, is found in soils deep and fertile in the northern parts of New York, and is common on some of the islands of the river Susquehanna. Near the great swamps of South Carolina and Georgia it is almost invariably accompanied by the magnolia grandiflora and swamp chestnut oak. It is of humbler growth than the magnolia grandiflora, seldom attaining to thirty or thirty-five feet in height, with a diameter of five or six inches. The leaves are eighteen or twenty inches long, and seven or eight broad; the flowers are white, and seven or eight inches in diameter. The fruit is four or five inches long and two inches in diameter. The wood is light and porous, and unfit for use. The tree is highly ornamental and very hardy. Introduced into England in 1752.

*Magnólia auriculata*, long-leaved cucumber-tree, is equally remarkable with the magnolia tripetala, for the beauty of its foliage and the size of its flowers, which are also of an agreeable odour, and is found, Michaux observes, only in a small tract far retired in the

country, at the distance of 300 miles from the sea, on a part of the Alleghany mountains. In its native soil it attains to forty or forty-five feet, and a diameter of twelve or fifteen inches. The leaves are of a light green colour, of a fine texture, eight or nine inches long, and from four to six inches broad; the base of the leaf is divided into rounded lobes, whence the name ear-leaved. The flowers are white, and from three to four inches diameter. The wood is light and spongy, and unfit for the purposes of the carpenter. The bark is stated to have an agreeable aromatic odour, and an infusion of it in ardent spirits is employed as an excellent sudorific in rheumatic affections. It is a hardy tree, and very ornamental for parks. Introduced into England in 1786.

*Magnólia macrophy'lla*, vel *Michauxii*, large-leaved cucumber-tree, is more remarkable for the superior size of its leaves and flowers than any other species of this genus. It resembles most the magnolia tripetala in its general habit of growth, and it is generally found growing in company with it. The leaves are sometimes thirty-five inches long, and nine or ten inches broad. The flowers are white, fragrant, and larger than those of any other species of magnolia, being sometimes eight or nine inches in diameter; the buds are compressed, instead of being rounded at the end, as in the magnolia tripetala, and they are covered with a soft and silvery down: this circumstance affords a ready distinction between these species at that season when the flowers and leaves are absent. The wood is of an inferior quality. The tree is highly ornamental. In its native soil, according to Michaux, it grows to the height of thirty-five feet. Introduced into England in 1800.

The other species of magnolia or cucumber-tree in the gardens of England, come at present, or as far as experience of their habits in this climate indicates, exclusively under the head of ornamental plants or shrubs, and consequently they are omitted in this enumeration.

TULIP-TREE. LIRIODENDRON.

*Calyx*, three-leaved; *petals*, six; *seeds*, into a strobule, or cone.

*Time of sowing seed*—spring. *Soil*, light earth, to be shaded from the heat of the mid-day sun.

*Uses*—The wood is esteemed for its lightness and durability, and in the western states of North America it is used as a substitute, in building, for the wood of the pine. The inner bark of the branches and root is used as a substitute for the Peruvian in remittent and intermittent fevers. It delights in a light rich loamy soil. It has been known to measure 22 feet in circumference, and to rise to 120 feet in height. Introduced into England in 1688.

*Species for Ornament, Shelter, or Underwood.*

Common.....*tulipifera*..N. Amer. ..60
Var. Entire lvd. ..*integrifólia* —— —

## TILIACEÆ.

*Polyandria Polygynia. Linn.*

*Trees of the habits and general appearance of the common Lime or Linden-tree.*

LIME-TREE. TILIA.

*Calyx*, five-parted; *corolla*, five-petaled; *capsule*, coriaceous, globular, five-celled, and five-valved, opening at the base; *seed*, one or two in each cell, roundish, covered with a coriaceous globular-shaped capsule, which has five valves, five cells, and opening at the base.

*Time of sowing seed*—Autumn, in a shady border of moist, light soil; but the usual mode of propagation is by layers. *Soil*—in almost any kind of soil, if moderately damp.

*Uses*—The wood is light, delicately white, and of an uniform texture, useful for some domestic purposes, and for those of the carver. Gibbon's inimitable carvings of flowers, dead game, &c., were of this wood, Br. Fl., vol. iii. p. 18. The bark of this, and probably of other species of lime, makes the Russian mats called *bast*. As an ornamental tree, the lime is esteemed for the fragrance of its flowers, of which bees are very fond.

Mr. Boutcher says, at eleven years old the plants will be twenty feet high; and at sixteen years old, from thirty to thirty-five feet high. The common yellow twigged lime, called also linden tree, and smooth-leaved lime, was formerly more than now a great favourite with planters. Whether it be properly a native of Britain, seems

to be uncertain, but that it has been long naturalized in this country is certain. A lime tree is described by Dr. Turner as growing near Colchester, which must have been cultivated in England before 1562. Du Hamel states that the French, in the reign of Louis XIV., growing tired of the horse chestnut, adopted this tree; and Sir James Smith, in his English Flora, observes that it generally composes the avenues about the residences of the French as well as English gentry of that date, and that Fenelon, in conformity to this taste, decorates with 'flowery lime trees' his enchanted isle of Calypso. The fragrance of the flowers are well known; they constitute an useful ingredient in *pot-pourri*. Bees are attracted, in great numbers, to collect honey from the flowers, in the season of flowering. The wood is smooth, delicately white, and uniform in its texture (vide p. 11, fig. *p.*); it is observed to be little subject to the attacks of insects. The beautiful carvings of Gibbon, before mentioned, which are dispersed about the kingdom, as in the choir of St. Paul's, Trinity College Library, at Cambridge, the Duke of Devonshire's, Chatsworth, &c. are stated to be of this wood*. It is also used by the turner in manufacturing light bowls, and boxes for the apothecary. The bark contains much mucilage; by maceration it separates into thin tough layers, which are manufactured into garden-mats, sometimes termed *bast mats*. These are well known to form a considerable part of the exports from Russia.

The broad-leaved lime, *tilia grandifolia*, attains to as large a size as the common linden; the young wood of the shoots is often red. The leaves have rather longer foot-stalks, the *ribs* and *veins* minutely hairy, or curiously fringed above the origin of each; all the under side of the leaves is finely downy, but not glaucous, as in the *tilia parvifolia* and American limes. This species, or, perhaps, variety, has been found in woods and hedges at Whitstable, Surrey; on the banks of the Mole, near Boxhill, by Mr. E. Forster; near Streatham Wells, Surrey, by Mr. Dubois; and in Stoken-church woods by Mr. Bicheno, but apparently planted*. This is stated to be the wild lime of Switzerland and the south of Europe, as the common species, *europæa*, is of the north. The *coral lime* is so nearly allied to this species, as to be considered by some botanists a variety only.

The small-leaved lime, *tilia parvifolia*, flowers about a month later than the last-mentioned tree. It is supposed to be the only true native species of lime. It is to be found frequent in Essex, Sussex, and Lincolnshire, and elsewhere, according to Ray. The leaves are much smaller than those of the above, being about two inches broad, dark green, and quite smooth above, glaucous underneath, with brown hairy tufts at the origin of each of their principal veins, as well as broad hairy blotches frequently found scattered over their surface. The comparative value of the timber of these last-mentioned species has not yet been determined. Among the American species of this tree the *smooth* or *bass-wood*, *tilia Americana*, is distinguished. Michaux informs us that he found it most abundant in Gennesse, which borders on Lake Erie and Ontario. In some districts between Batavia and New Amsterdam, it constitutes two-thirds, and sometimes the whole of the forests. It attains to the largest size in a loose deep fertile soil. It is found 80 feet in height, and 4 feet in diameter. The wood is white and tender, and is, in some places, substituted for that of the tulip-tree for the panels of carriage bodies, and the seats of Windsor chairs.

The white lime, *tilia alba*, is chiefly found on the banks of the Ohio, Susquehanna, and those of the streams which empty into them. The same authority observes, that it rarely exceeds 40 feet in height, and 12 or 18 inches in diameter.

The downy lime, *tilia pubescens*, is a native of the Floridas, and Southern parts of the United States. It resembles the American lime tree more than the preceding. The leaves are very downy on their under side, obliquely truncated at the base, and edged with fewer teeth than the other

* Evelyn's Sylva.

* Engl. Fl., vol. iii. p. 19.

species. The flowers are also more numerous, and produced in larger bunches. The wood has not been proved as to its properties. All these trees are ornamental, and afford a cool shade in summer.

*Timber or Forest Species.*

| LIME-TREE. | TILIA. | Native of | Ft. |
|---|---|---|---|
| Red-twigged Lime-tree | *rúbra* | Britain | 50 |
| Yellow | *európæa* | Britain | 50 |
| Var. Jagged-lvd. | *laciniáta* | Britain | 30 |
| White | *álba* | Europe | 30 |
| Downy-leaved | *pubéscens* | Carolina | 20 |
| Smooth | *grandifólia* | Britain | — |
| Var. coral-twigged | *corallina* | Britain | — |
| Broad-leaved | *glábra* | N. Amer. | 30 |
| Silvery-leaved | *argéntea* | Hungary | — |

*Species for Ornament, &c.*

| | | | |
|---|---|---|---|
| Long-petaled | *petioláris* | —— | — |

## ACERINEÆ.—*Nat. Sys.*

*Polygamia Monœcia. Linn.*

| Eng. Name. | Bot. Name. |
|---|---|
| MAPLE-TREE. | ACER. |

*Calyx*, five-cleft; *corolla*, five-petaled; *germs*, two or three superior; *style*, simple; *seed*, single, roundish shaped, its capsule terminated by a wing-like membrane.

*Time of sowing*—as soon as possible after the seeds are ripe: some are of opinion that the seed should be preserved in dry sand until February or the beginning of March. *Soil*—This genus will thrive in coarse land, but the European species attains the greatest size in a deep, moist soil, free of stagnant moisture; those which are natives of America require a drier soil than the above.

*Uses*—The wood of the common maple or sycamore is considered superior to that of the beech for the uses of the turner, in making domestic utensils, and also for the uses of the joiner for inlaying. It is sometimes also used by musical instrument-makers; but it is chiefly valued for its property of quick growth as coppice or underwood.

*Timber or Forest Species.*

*Polygamia Monœcia. Linn.*

| MAPLE-TREE. | ACER. | Native of | Ft. |
|---|---|---|---|
| Common | *campéstre* | Britain | 35 |
| Italian | *ópalus* | Italy | 50 |
| Norway | *platanoides* | Europe | 50 |
| Sycamore (in Scotland, Plane-tree.) | *pseúdo-plátanus* | Britain | 50 |
| Sugar* | *saccharinum* | N. Amer. | 40—70 |

*Species for Ornament, Shelter, or Underwood*

| | | | |
|---|---|---|---|
| Striped-leaved, or variegated | *pseúdo-plátanus* / *variegátum*, | Britain | |
| Blunt-leaved | *obtúsum* | —— | |
| Sir C. Wager's | *dasycárpum* | N. Amer. | |
| Bastard | *hýbridum* | Hybrid | |
| Cut-leaved | *platanoides* / *laciniátum* | Europe | |
| Mountain | *montánum* | N. Amer. | 8 |
| Ash-leaved | *negúndo* / *fraxinifólium* | —— | 30—40 |
| Scarlet-leaved | *rúbrum* | —— | |
| Tartarian | *tatáricum* | Tartary | |

* In America this tree is called rock maple, hard maple as well as sugar maple. It is no where more abundant than between the 46th and 43d degrees of latitude, which comprise Canada. According to Dr. Rush, there are *ten millions of acres* in the northern parts of the states of New York and Pennsylvania, which contain these trees in the proportion of thirty to an acre. The wood is rejected in civil and naval architecture, but the wood of old trees is esteemed for inlaying mahogany, and is termed *bird's-eye maple*. To obtain the finest effect caused by the inflection of the medullary rays, which produce spots resembling the eye of birds, the log should be sawn in a direction as nearly as possible parallel to the concentric circles. The ashes are rich in alkaline principle; and it is asserted that four-fifths of the potash exported to Europe from Boston and New York, are furnished by the sugar maple. The sugar maple begins to be found wild in Canada, near the 48th degree of latitude, a little north of Lake St. John, and, as above stated, is most abundant between the 46th and 43rd degree. It is very rare in the lower parts of Virginia, the Carolinas, and Georgia. It flourishes best where the soil, though rich, is cold and humid, and situated on elevated declivities. But the great value of the sugar maple in America consists in the superior quantity of sugar afforded by the sap of the tree. In February or March, while the ground is covered with snow, and the cold is still intense, the tree is bored to the depth of half an inch within the wood, with an auger three-quarters of an inch in diameter, and in an obliquely ascending direction, on the south side of the tree, and at about eighteen or twenty inches from the ground. There are two holes made in this manner, four or five inches apart. Tubes of eight or ten inches long, and three-quarters of an inch in diameter, made of elder or sumac, having a portion of their length laid open, are inserted into them to conduct the sap into troughs, which are made to contain two or three gallons. The sap continues to flow or yield sugar, Michaux observes, for six weeks, after which it declines in quantity and quality. Four gallons of sap are considered to give one pound of sugar, and from two to four pounds is mentioned as the produce of a tree. Sheds are erected near the trees, where the persons who conduct the process of boiling the sap and extracting the sugar, are sheltered. Three persons are allowed to be sufficient to tend 250 trees, which give 1000 lbs. of sugar. It is stated that eighty millions of pounds of sugar are consumed in the United States, of which fifty millions are imported, ten millions furnished by the sugar cane of Louisiana, and ten millions from the maple. Of the other maples above enumerated, their comparative value, as timber trees, has not been sufficiently proved to allow of separate notices in the limits of these pages.

Montpelier.....*monspessulánum* France
Oblong-leaved ...*oblóngum*...Nepaul
Striped-barked...*striátum* ...N. Amer.
Opalus-leaved....*opalifólium*. S. Europe
Hungarian.....*obtusátum* ..Hungary
Cretan .....*créticum* ...Levant
Evergreen.....*heterophýllum* ——
Bearded .....*barbátum* ..N. Amer.
Black Sugar.....*nigrum* .... ——
Palmate .....*palmátum*..China
Large-leaved....*macrophýllum*. Columbia
Iberian .....*ibéricum* .....Iberia
Round-leaved ...*circinnátum* .. Columbia

## HIPPOCASTANEÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| HORSE-CHESTNUT. | ÆSCULUS. |

*Heptandria Monogynia. Linn.*

*Calyx*, one-leaved, five-toothed, ventricose; *corolla*, five-petaled, irregularly-coloured, inserted into the *calyx*; *capsule*, three-celled; *seeds*, two, sub-globular, enclosed in a roundish-shaped capsule, containing three cells, and opening with three valves to emit the seeds.

The seeds should be preserved in dry sand till spring, and sown early in that season; but should the soil be dry, and free from the attacks of vermin, it is advantageous to sow as soon as the seeds are ripe. *Soil*—The horse-chestnut grows to the largest size in a sandy loam, but will grow in almost any kind of soil.

*Uses*—for fuel; but chiefly planted for the beauty of its flowers and its habit of growth. The common horse-chestnut, though a native of the northern parts of Asia, is never injured by cold in Britain, into which it was introduced about 1689, or, according to some, in 1683. It is sufficiently known for the beauty of its form when in full foliage and in flower, particularly when planted singly or in rounded groups, in lawns, and parks. For avenues it is less desirable, or where it overshadows roads, as the leaves fall early in the autumn. The species enumerated below, natives of North America, are all more or less ornamental, and deserving of a station in the margins of forest plantations. The comparative value of their timber has not yet been proved.

*Timber or Forest Species.*

HORSE-CHESTNUT. ÆSCULUS.
Common.....*hippocastánum* Asia....40

*Species for Ornament, &c.*

HORSE-CHESTNUT. ÆSCULUS. Native of Ft.
Golden-striped...*hippocastánum, fol. qur.*
Silver-striped ... ——, *fól. arg.*
Double-flowered..*flóre pléno* .. ——
Flesh-coloured...*cárnea* ..... ——
Ohio .....*ohioénsis* ...Nor.Amer.

| Eng. Name. | Bot. Name. | | |
|---|---|---|---|
| BUCKS-EYE-TREE. | PAVIA. | | |
| Pale-flowered .... | *pállida* .... | N. Amer. | |
| Smooth-leaved ... | *glábra*..... | —— | |
| Long-spiked..... | *macrostáchya* | —— | |
| Variegated-flowered | *hýbrida*... | —— | |
| Dwarf..... | *discolor* .... | —— | |
| Neglected ..... | *neglécta* .... | —— | |
| Red-flowered .... | *rúbra* ..... | —— | 10—8 |
| Yellow-flowered.. | *fláva* ..... | —— | 40 |

## RHAMNEÆCEÆ. *Nat. Sys.*

| | |
|---|---|
| CHRIST'S-THORN. | ZIZYPHUS. |

*Pentandria Monogynia. Linn.*

*Calyx*, tubular; the scales of the *corolla* are inserted in the calyx, and support the stamina. *Seed*, a two-celled nut, covered by a berry.

*Time of sowing seeds*—Autumn, in pots. *Soil*—Sandy loam. *Uses*—Chiefly planted for the singularity of its spines or thorns.

*Species for Ornament, &c.*

Common.....*paliúrus*..S.Europe. Introduced in 1640.

| | |
|---|---|
| HOLLY. | ILEX. |

*Tetandria Tetragynia. Linn.*

*Calyx*, four-toothed; *corolla*, wheel-shaped; *style*, wanting; *seeds*, four, solitary, horny, oblong, rounded on one side, cornered on the other, enclosed in a roundish four-celled berry.

*Time of sowing*—The berries should be placed under ground in a pot or large tub for one year, and then sown in the autumn upon a bed of sandy loam. *Soil*—The holly flourishes best in a dry, sandy soil, but will grow on land of almost any description. *Uses*—for the purposes of the turner, the inlayer, mill-wright, and engineer. The tree is in great esteem for the ornament of its evergreen foliage. Bird-lime is manufactured from its bark. The common holly, besides being a native of England, is also found wild in many parts of Europe, Japan, Cochinchina, North America, &c. As an evergreen fence it is superior to every other plant. It bears clipping

well, and is never injured by the severest frost. When reared to the height of two feet, by transplanting from the seed bed to a rich sandy soil, the plants may be removed, and planted as a hedge with perfect safety on well trenched and manured ground; this removes the only objection to the holly for fences, which is its slow growth. We have moved plants four feet in height successfully, and thus made a comparatively impenetrable live-fence the first season.

The *Carolina*, or *American Holly*, attains to a great height in its native soil. Its wood is held in great estimation, but in this respect it is not considered superior to that of our native species.

*Species for Ornament, &c.*

| HOLLY. | ILEX. | | |
|---|---|---|---|
| Common..... | *aquifólium*.. | Brit. | 20—30 |
| Var. Various-lvd... | *heterophýlla* | — | |
| „ Thick-leaved . | *crassifólia*, . | — | |
| „ Hedgehog... | *férox*..... | — | |
| „ Striped do.... | *echináta* ... | — | |
| „ Yellow-berried . | *fláva*, .... | — | |
| „ White-margined ..... | *álba marginata* ... | — | |
| „ Gold-edged .. | *áurea marginâta* | | |
| „ Painted ..... | *média pìcta*. | — | |
| „ Spineless.... | *senéscens*... | — | |
| „ Milk-maid ... | *lactária*.... | — | |
| „ Carolina..... | *opáca*..N. Amer. | | 30 |

JUGLÁNDEÆ. *Nat. Sys.*

*Monœcia Polyandria. Linn.*

| Eng. Name. | Bot. Name. |
|---|---|
| WALNUT-TREE. | JUGLANS. |

MALE FLOWER—ament or catkin, imbricated—*calyx*, scaly; *corolla*, six-parted; *filaments*, many, seven or more. FEMALE FLOWER—*calyx*, of four divisions, superior; *corolla*, with four divisions; *styles*, two; *seed*, a nut with four divisions, marked by intervening membranes, substance of the seed grooved—it is covered by a corticated, dry, oval-shaped, two-valved drupe.

*Time of sowing*—Preserve the nuts until February in their outer covering, after which they may be sown. *Soil*—A rich loamy soil is that in which the walnut attains the largest size, but it will succeed in very light, siliceous, sandy soils, as well as in clayey ones. *Uses*—The wood of the walnut is highly valued for many purposes, such as gun-stocks, domestic utensils, furniture, wainscoting, &c. Among the American Walnuts, the black, *Juglans nigra*, is considered to have wood of a more valuable quality than the common walnut, but this latter has a decided superiority in the excellence of its fruit and properties of its oil. The black walnut is considered to be one of the largest trees of America. On the banks of the Ohio, and on the islands of that river, Michaux states that he has found them from sixty to seventy feet in height and four feet in diameter, and that it is not rare to find them six or seven feet. Of the Hiccories, the Pignut, or Cárya *porcína*, is perhaps the most valuable, not for its fruit, but for its wood, being comparatively the best. The comparative value of these trees has not yet been proved in England—hitherto they have been looked upon as merely ornamental park trees, or subjects for botanical investigation. Some of them, however, rank among the largest trees in North America, where, according to Michaux, the general opinion there formed of the wood of the different species cut out from the natural forests is, that it is of great weight, strength, and tenacity, but liable to a speedy decay when exposed to damp, heat, and to worms

*Forest or Timber Species.*

Filaments of the female flower many.

| WALNUT-TREE. | JUGLANS. | Native of | Ft. |
|---|---|---|---|
| Common..... | *régia*..... | Persia... | 50 |
| Var. Dble.-fruited. | *reg.máxima*. | — | — |
| „ Late-fruited.. | *reg.serotína*. | — | 30 |
| Black ..... | *nigra*..... | N.Amer.. | — |
| Shell-bark..... | *cinérea* .... | — | |
| Ash-leaved ..... | *fraxinifólia* | — | |
| Winged-fruited .. | *pterocárpa* . | Caucasus | |
| Hiccory-nut .... | *cárya*..... | — | |
| Filaments of the female flower | | — | 4 to 6 |
| White hickery, or Shagback..... | *álba*..... | — | |
| Olive-fruited or.. Pecannut .... | *olivæfórmis*. | — | 60* |
| Flat-fruited ..... | *compréssa*.. | — | |
| Smooth-leaved ... | *glábra*..... | — | |
| Narrow-leaved ... | *angustifólia*. | — | |
| Bitter nut..... | *amára* ..... | — | 70 to 80 |
| Pig nut..... | *porcína* .... | — | |

CONNARACEÆ. *Nat. Sys.*

*Polygamia Monœcia. Linn.*

| Eng. Name. | Bot. Name. |
|---|---|
| TREE OF HEAVEN. | AILANTHUS. |

MALE FLOWER—*calyx*, one-leafed, five-

* Michaux gives the character of the fruit as the finest flavoured of all the American walnuts, and to be more delicate than the European species. He advises it to be grafted on the common walnut.

parted, very small; *corolla*, five petals, acute, convolute at the base; *stamina*, filaments ten, compressed, the length of the corolla.

FEMALE FLOWER—*calyx*, as in the male; *corolla*, as in the male; pistil, germs 3—5; *styles* lateral; *capsules*, compressed; *seeds*, solitary; lens-shaped. Bisexual flowers as in the above.

| | | Native of | Ft. |
|---|---|---|---|
| Tall Ailanthus, or Tree of Heaven | *glandulósus* | China | 50 |

Though a native of China, this tree bears our winters without injury. It grows fast, and attains to a great height; there are many trees of this kind in England from thirty to forty feet and more in height. It is a handsome tree, and the wood is said to be hard, heavy, and glossy, like satin, and susceptible of the finest polish. It is well worthy the attention of those who have it in their power to benefit themselves and the nation, by determining the comparative value of the different species of forest-trees. Some remarkable fine specimens of this and of comparatively rare American forest-trees, are in the grounds of the Duke of Northumberland at Syon.

*Time of sowing the seeds*—As soon as they are received from abroad in boxes of light earth, or sand and peat, protected under glasses.

## LEGUMINOSÆ. *Nat. Sys.*

### GLEDITSCHIA, OR SWEET LOCUST.

BISEXUAL FLOWER—*calyx*, four-cleft; *corolla*, four-petaled; *stamina*, six; *pistil*, one. MALE FLOWER—*calyx*, three-petaled; *stamina*, six. FEMALE FLOWER—*calyx*, five-leaved; *corolla*, five-petaled; *pistil*, one.

*Seeds*, solitary, roundish, hard, shining, enclosed in a legume or pod, which is broad, much flatted, and divided by several transverse partitions.

*Time of sowing the seed*—Seeds procured from America, sow half an inch deep; they frequently remain two years in the ground before they vegetate. *Soil*—A sandy loam. *Uses*—This plant is valued for the beauty of its habit of growth. If planted in exposed situations, the branches are apt to be broken by the winds.

*Polygamia Diœcia. Linn.*

| SWEET LOCUST. | GLEDITSCHIA. | Native of | Ft. |
|---|---|---|---|
| Thr.-thorned acacia | *triacánthus* | N.A. | 40 to 60 |
| Var. Spineless | *inérmis* | —— | 30 to 40 |
| Single-seeded, or water acacia | *monospérma* | —— | |
| Strong-spined acacia | *hórrida* | China | |

(*Subordo, Papilionaceæ.*) *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| SOPHORA. | SOPHORA. |

*Decandria Monogamia. Linn.*

*Calyx*, four-toothed; *corolla*, pea-flowered; *seed*, pod, long, slender, one-celled, numerous, forming prominent knobs on the surface of the pod.

*Time of sowing seed*—as soon as it can be procured; sow in pots filled with light earth. Plant in a sandy loam, and in a sheltered situation. *Use*—Valued for its handsome foliage and habit of growth.

| SOPHORA. | SOPHORA. | | |
|---|---|---|---|
| Japanese sophora | *japónica* | Japan | 40 |

The wood of this tree, when fresh cut, emits an odour offensive to insects. In England we have seen it attain to upwards of 20 feet in height, with a proportionate diameter. Its pinnated leaves, which are smooth and of a beautiful green, give to the tree a graceful appearance. It is a native of Japan, and was introduced into England in 1753.

FURZE, WHIN, GOSE. ULEX.

*Monadelphia Decandria.—Linn.*

*Calyx*, of two ovate-oblong concave leaves, rather shorter than the keel; the upper with two small teeth, the lower with three; *corolla*, of five petals; standard, ovate-cloven; wings, oblong, rather shorter than the standard; keel, of two petals, straight, obtuse, cohering by their lower edges; filaments, in two sets, both united at the base; *anthers*, roundish, of two lobes; *germen*, oblong, nearly cylindrical, hairy; *legume*, or *seed-pod*, oblong, turgid, scarcely longer than the calyx of one cell, and two rigid elastic concave valves; *seeds*, from six to eight, polished, somewhat angular, slightly compressed, with a cloven tumid crest.

*Species for Underwood, Fencing, &c.*

| FURZE. | ULEX. | Native of | Ft. |
|---|---|---|---|
| European, or Common | *europæ'us* | Britain. | |
| Dwarf | *nánus* | —— | |
| Provence | *provinciális* | S. Europe. | |

*Time of sowing the seed*—as soon as ripe in the autumn, or in March. *Soil.*—Dry, sandy, and gravelly soils suit best the growth of furze. It does not

however grow well on very thin heath soil, nor on damp clays. In Cornwall the common sort (*ulex europæus*) attains to 8 feet in height. In Devonshire, according to Vancouver, this species is termed French furze, although we suspect the *ulex provincialis* is the species which ought to come under this name. In some places the *ulex nana* is called French furze. The botanical distinctions are as follow:—

The Common Furze, *Ulex Europæus.*
*Branches*, erect, somewhat villous; *calyx*, pubescent, teeth obsolete converging, bracteas densely downy, oval, loose.

French Furze, *Ulex Provinciàlis.*
*Branches*, erect, somewhat smooth; *calyx*, a little pubescent, nearly as long as the corolla, teeth lanceolate, distant, bracteas minute, compressed.

Dwarf Whin, or Furze, *Ulex nàna.*
*Branches*, decumbent, hairy; teeth of the *calyx*, lanceolate, distant, and spreading; *bracteas*, minute, rounded, and close pressed.

From the above it is evident that the common furze and the French species are nearly allied; the dwarf furze has the leaves or spines shorter and closer, and the branches decumbent. These points of structure distinguish this species from the others at the first sight. Its value is estimated, in comparison to that of the common, as two to one inferior.

The common furze generally attains to its full size in four years, and it ought not to be cut more frequently. In local cases, as in the neighbourhood of potteries, Vancouver observes it makes a return of from 15*s.* to 20*s.* an acre annually. The wood is very hard, but never attains to a size available for the business of the carpenter. It is chiefly used for fuel, fences, and food for cows, horses, and sheep. On soils such as now alluded to, it makes a good fence, but requires peculiar management to prevent it becoming naked at the root. Sowing in three tiers on a bank is perhaps the best mode, as it allows of one to be kept low by the shears or bill, the second of higher growth, and the last to attain its natural stature. Respecting its merits as an article of fodder, a good deal has been written; as, for instance, by Duhamel in France, Evelyn in England, and Doctor Anderson in Scotland; and at this time, and for that purpose, as we are informed, it is cultivated successfully by Mr. Attwood of Birmingham. It requires to be chopped or bruised, as a preparative to its mastication. It would be valuable information to know the *comparative value* of the Whin to that of Lucern, Turnip, Red Clover, cultivated separately, or a combination of *Dăctylis glomerăta, Lólium perénne, Festúca duriúscula, Póa pratènsis, Cynósurus cristátus, Lótus corniculátus, Phléum pratènse, Trifólium répens, Trifólium minus, Medicágo lupulina*, and a small portion of *Achillea millefolium*. The produce of plants constituting the richest pasture plants, when combined on a furze soil, are proper to compare with the produce of furze, to ascertain the most profitable crop with which to occupy the soil in question, and this point has not yet been determined.

| Eng. Name. | Bot. Name. |
|---|---|
| LABURNUM. | CYTISUS. |

*Calyx*, labiate; *legume*, or *seed-pod*, tapering at the base; *seed*, kidney-shaped, compressed.

*Time of sowing seed*—March. *Soil*—This tree attains the greatest perfection on a sandy loam, but it may be planted in almost any kind of soil, except where stagnant moisture prevails. *Uses*—Although an ornamental tree, yet its wood or timber is valuable for various kinds of fancy wood-works, such as musical instruments, handles of knives, &c. The wood is very hard, takes a fine polish, and, when of sufficient size, may be manufactured into the most elegant kinds of furniture.

In the species here enumerated, the pods are one or two-jointed, joints globular.

*Species for Timber as well as for Ornament, &c.*

*Monadelphia Decandria. Linn.*

| LABURNUM. | CYTISUS. | |
|---|---|---|
| Com. laburnum .. | *labúrnum* .. | Eur. . 10—25 |
| Scotch laburnum . | *alpínus*. . . . | |

ROBÍNIA, or LOCUST-TREE, FALSE ACACIA, &c. ROBÍNIA *.

*Calyx*, one-leafed, four-cleft; *legume*, compressed, long, gibbous; *seed*, kidney-form.

*Time of sowing the seed.*—The end of March, on a bed of light earth. The

* So named by Linnæus in honour of J. Robin, a French botanist, who first introduced the tree into France from Canada, in the reign of Henry IV., about the year 1601.—Mich.

following spring transplant the seedlings in nursery rows about the end of March, the rows to be three feet apart, and the plants a foot and a half asunder in the rows. In one or at most two years they should be planted out where they are intended finally to remain. *Soil*—It will grow in almost any soil, but attains to most perfection in such as is light and sandy. *Uses*—The wood is hard and very durable. It is esteemed, in America, preferable to the best white oak for axle-trees of carriages, trenails for ships, posts for rail-fencing, and for withstanding the bad effects of moisture when fixed in damp ground. It is frequently substituted for box by the turners, for the manufacture of sugar-bowls, salt-cellars, candlesticks, forks, spoons, &c. It was cultivated in England in 1640, by Mr. John Tradescant, or nearly two hundred years ago. But the only satisfactory authenticated statements we can find of the greatest age of Locust trees now growing in England (with that of their produce of timber) does not exceed sixty years. A locust-tree, in the grounds of the late Charles Bloomfield, Esq., Bury St. Edmond's, of sixty years growth, in 1829, measured in height from forty to fifty feet, and the circumference at three feet from the ground six feet seven inches, the solid contents being fifty-four feet of timber*. The limits of these pages do not permit further details, except to observe that, owing to the brittle nature of the wood when young, the leading shoots of the stems, as well as the branches, are very liable to be broken by the wind, and probably it is from injuries of this kind that many trees are found unsound even before forty years of growth: great attention to early training or pruning appears to be required by the locust. The comparative strength as to fracture of its timber compared to that of oak, appears to be in favour of the former, according to Professor Barlow, fine English oak 1672 to locust 1867. The comparative value of the timber of the other different species of Robinia mentioned below, has not yet been ascertained: their value for ornament is well known.

* Withers MS. Correspondence.

*Diadelphia Decandria. Linn.*

| ROBINIA. | ROBINIA. | Native of | Ft. |
|---|---|---|---|
| Locust-tree, or False Acacia | *pseudo acácia* | N. Am. | 35-50 |
| Clammy | *viscósa* | —— | 30-40 |
| Spineless | *inérmis* | —— | — |
| Long-leaved | *macrophýlla* | Siberia | — |
| Parasol | *umbraculifera* | —— | — |
| Upright | *stricta* | —— | — |
| Pendulous | *péndula* | —— | — |
| *Ornamental only.* | | | |
| Rose Acacia | *hispida* | Carolina | 60 |
| Purple | *purpúrea* | —— | — |
| Smooth-branched | *rósea* | Carolina | — |

| Eng. Name. | Bot. Name. |
|---|---|
| KENTUCKY COFFEE-TREE, OR HARDY BONDUC. | GYMNOCLADUS. |

*Diœcia Decandria. Linn.*

MALE FLOWER—*Calyx*, five-toothed; *corolla*, five petalled. FEMALE FLOWER—the same as the male; *stile*, one; *legumen*, one-celled; *seeds*, several, embedded in a pulp. Propagated by suckers from the root, as well as from seed.

Kentucky Coffee-tree *Canadensis* N. Amer. 40

There is only one species of this tree. In its native soil of that part of Genesee which borders on lake Ontario and lake Erie, and in the states of Kentucky and Tennessee, Michaux states it to attain to fifty or sixty feet in height, and that the stem is often destitute of branches for thirty feet, while the diameter seldom exceeds twelve or fifteen inches. In summer, when it is fully grown, it has a fine appearance. On young trees the leaves, which are doubly compound, are three feet long and twenty inches wide. The bark is very rough, and detaches itself in small vertical strips. The name of coffee was given to this tree by the early emigrants to Kentucky. The seeds appear to possess no culinary value. The wood is very compact and of a rosy hue, which fits it for the use of the cabinet-maker. Michaux observes that, like the locust, it exhibits almost nothing but heart-wood, for that six inches in diameter has only six lines of sap-wood. These qualities, he observes, recommend it for culture in the forests of the north and centre of Europe. It was introduced into England, in 1748, by Archibald Duke of Argyle, but its culture appears not to have extended beyond the garden.

## AMYGDALINÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| ALMOND-TREE. | AMYGDALUS. |

*Icosandria Monogynia. Linn.*

*Calyx*, five-cleft, inferior; *petals*, five; *seed*, a nut, oval-shaped, compressed, acute, with prominent sutures on each side, netted in four rows and dotted, enclosed in a villose or woolly drupe.

*Time of sowing seed*—Autumn; cover with light dry earth, three inches deep. *Soil*—A sandy loam, in a sheltered situation. *Uses*—Gay and ornamental flowers in the spring: the naked seed of the almond, properly so called, yields an essential oil, and, by trituration, forms an emulsion, or cooling beverage, much used.

The naked seed or almond of the *Amygdalus amara* affords an oil of similar properties to that of the *Amygdalus communis*, but the bitter principle contained in the farinaceous part of the seed is deleterious, containing prussic acid.

*Species for Ornament, &c.*

| ALMOND-TREE. | AMYGDALUS. | Native of | Ft. |
|---|---|---|---|
| Sweet almond.... | *communis* .. | Barbary .. | 18 |
| Bitter almond.... | *amara*..... | —— | — |
| Double blossomed | *flore pleno* (*Persica*) | Persia .... | — |
| Chinese ..... | *cochinchinensis* | China | |

## POMACEÆ. *Nat. Sys.*

| | |
|---|---|
| MESPILUS. | MESPILUS. |

*Icosandria Di-pentagynia. Linn.*

*Calyx*, five-cleft; *petals*, five; *berry*, inferior; *seeds*, five, bone-like, enclosed in a globular berry.

*Time of sowing the seed*—autumn, or as soon as ripe. *Soil*—a rich loam; but it will succeed in any description of soil free from the extremes of moisture and dryness. *Uses*—for its ornamental habit of growth and its fruit.

*Species for Ornament, &c.*

| MESPILUS. | MESPILUS. | | |
|---|---|---|---|
| Medlar, common.. | *Germanica* | England . | 12 |
| Var. Uprt. medlar. | *stricta*..... | —— | — |
| " Dutch ..... | *diffusa*..... | —— | — |
| Quince-leaved mespilus..... | *tomentosa* | | |
| Tansy-leaved hawthorn ..... | *tanacetifolia* | Greece ... | 12 |
| Large-flowered mespilus ..... | *grandiflora* | S. Europe. | — |

| Eng. Name | Bot. Name |
|---|---|
| PEAR-TREE. | PYRUS. |

*Calyx*, five-cleft; *petals*, five; *seeds*, several, oblong, blunt, accuminate at the base, convex on one side, flat on the other, enclosed in a pome or apple, fleshy, with five membranous cells.

*Time of sowing the seed*—Spring: preserve the seed during winter in dry sand. *Soil*—rich clayey loam, but also on gravelly and chalky soils on elevated, exposed situations. *Uses*—for underwood, ornamental blossoms and fruit: the white beam (pyrus aria), however, is considered by some to rank as a timber-tree; the wood, tough and hard, is sometimes used for axletrees, handles of tools, &c. The wood of the wild service-tree (torminalis) is likewise applied to the same purposes, and its fruit is frequently brought to market.

*Species for Ornament, &c.*

| PEAR-TREE. | PYRUS. | Native of | Ft. |
|---|---|---|---|
| Arbutus-leaved.... | *arbutifol.*.. | Virginia | |
| Var. Red-fruited arbutus-leaved | *rubra* .... | —— | |
| " White-fruited arbutus-leaved | *alba*..... | —— | |
| " Black-fruited arbutus-leaved | *nigra*..... | —— | |
| Snowy..... | *nivalis* .... | Austria. | |
| Wild pear-tree ... | *communis* .. | England | |
| Woolly-leaved ... | *pollveria* ... | Germany | |
| Crab-tree..... | *malus* ..... | Britain | |
| Chinese apple ... | *spectabilis* .. | China | |
| Siberian crab .... | *prunifolia* .. | Siberia | |
| Small-fruited crab | *baccata* .... | —— | |
| Sweet-scented crab | *coronaria* .. | Virginia | |
| Narrow-lvd. crab . | *angustifolia*. | N. Amer. | |
| Com. quince-tree.. | *cydonia* .... | Austria | |
| Willow-lvd. crab.. | *salicifolia* .. | Levant | |
| White beam-tree . | *aria* ..... | Britain | ..30 |
| Swedish do. ..... | *intermedia*.. | Sweden | |
| Wild service pear-tree ..... | *torminalis* | Eng. . | 30—40 |

| | |
|---|---|
| AMELANCHIER. | AMELANCHIER. |

*Icosandria Pentagynia. Linn.*

Snowy Amelanchier. *botryapium*. N. Amer.

### CRATÆGUS.

*Calyx*, five-cleft; *berry*, inferior; *seeds*, two, roundish, umbilicated, body somewhat long, distinct, cartilaginous.

*Time of sowing seed*—Autumn. *Soil*—will succeed in almost any kind of soil of intermediate quality as to moisture and dryness: the most ornamental and useful of the species are the vari-

eties of the common hawthorn (oxyacantha), the Glastonbury is remarkable for the season of the year in which it comes into flower, which is usually in January or February, and sometimes at Christmas, according to the state of the weather then, and of that during the previous summer and autumn. The wood of the common Hawthorn is hard and tough, and is esteemed for axle-trees, handles of tools, &c. When planted singly it not unfrequently rises to 20 or even 30 feet in height; and we have measured stems of individual trees of this species, varying from 3 to 7 feet in circumference. The merits of this and the interesting species and varieties mentioned below, for ornament in park scenery, come more properly for discussion under the second division of the subject of Planting, proposed in the introduction to this treatise: but though their value, in an economical point of view, has not yet been determined, their natural habits and growth offer matter well worthy the attention and investigation of the forest-planter, and they are therefore here enumerated. *Uses*—The common hawthorn, it is well known, is used for making quick or live fences. It is of great importance to have the plant strong and large before finally planting it in the hedge-row. This plant delights in a deep soil, and where it is not naturally such, its depth ought to be increased. When the plants or quicks are large, they produce a fence in a short space of time, and save much expense in weeding, nursing, and temporary fencing.

*Species for Ornament, &c.*

| CRATÆGUS. | | Native of | Ft. |
|---|---|---|---|
| Great American hawthorn .... | *cratægus coccínea*.... | N. Amer. | |
| Maple-leaved.... | —*cordáta* .. | —— | |
| Pear-leaved..... | —*pyrifólia* | —— | |
| Oval-leaved ..... | —*elliptica* . | —— | |
| Hollow-leaved ... | —*glandulósa* | —— | |
| Yellow-berried ... | —*fláva* ... | —— | |
| Gooseberry-leaved | —*parvifólia* | —— | |
| Great red-fruited.. | —*punctáta*. | —— | |
| Var. Yellow-fruited | —*áurea* ... | —— | |
| Common cockspur | —*crusgálli* | —— | |
| Var. Pyracantha-leaved..... | —*pyracanthifólia* . | —— | |
| „ Willow-leaved | —*salicifólia* | —— | |
| White-thorn..... | —*oxyacántha* | Britain | |
| Var. Common.... | —*vulgáris*. | —— | |
| Var. Great-fruited | —*major* ... | —— | |
| „ Glastonbury . | —*præcox*.. | —— | |
| „ Dbl.-flowered. | —*pléna* ... | —— | |
| Yellow-berried . | —*áurea* ... | —— | |
| Parsley-leaved . | —*azarólus* . | S. Europe | |
| Elegant red ..... | —*élegans* | —— | |
| Sweet-scented ... | —*odoratissima*. | Crimea | |
| Woolly-fruited ... | —*eriocárpa*.. | Britain | |
| Sloe-leaved ..... | —*prunéllifólia*. | N. Amer. | |
| Cut-leaved ..... | —*dissécta*.... | Persia | |
| Comb-shaped .... | —*pectináta* .. | —— | |
| Frosted ..... | —*pruinósa*... | —— | |
| Crimson ..... | —*punícea*.... | Dahuria | |
| Black-berried .... | —*melanocárpa*. | Tauria | |

## OLEINÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| ASH-TREE. | FRAXINUS. |

*Polygamia Diœcia. Linn.*

BISEXUAL. MALE FLOWER—*calyx*, none, or a four-parted perianth; *corolla*, none, or four petals; *stamina*, two; *pistil*, one; *capsule*, one-seeded, terminated by a spear-shaped membranous wing. FEMALE FLOWER—*calyx*, none, or a four-parted perianth; *corolla*, none, or four petals; *pistil*, one; *capsule* and *seed*, the same as in the bisexual flower.

*Time of sowing the seed*—Autumn, as soon as ripe, or dry the seed in a cool airy loft, and preserve them in sand during the winter; and then in April sow them on beds of fresh mellow soil; the plants will appear in the following spring; but if sown in the autumn as soon as ripe, most of the plants will appear in the same season.

*Soil*—Clayey loam brings the ash to the greatest perfection, but it will grow on every description of soil. Evelyn mentions an ash-tree of 132 feet in height, and Young, in his Irish Tour, states the length of an ash, at thirty-five years growth, to be 70 feet.

*Uses*—This wood is hard and tough, and much esteemed for implements of husbandry, and also for the purposes of the coach-maker, cooper, turner, &c. It makes a profitable kind of underwood, and may be cut every eight years for hoops, and every fourteen years for hop-poles, &c. It is said that the leaves, when eaten by cows, give the butter which is made of their milk a rank taste; butter, however, in the spring, and towards autumn, has frequently a rank taste, when the cows yielding it are completely out of the reach of leaves of any kind of forest-trees whatsoever.

When planted in hedge-rows, the ash is apt to impoverish the soil around it in a greater degree than most other trees. This tree is by many considered to stand next in value to the oak. It is mentioned as such by the oldest writers*. Where pollard trees are permitted, the ash makes one of the most profitable. Dr. Withering states, that a decoction of two drachms of the bark has been used to cure agues. The Manna Ash, *Fráxinus rotundifólia*, in England seldom attains to more than 20 feet in height; the leaflets are shorter, of a deeper green colour, and more deeply serrated on the margins than those of the common ash. It is a native of Italy, and is most abundant in Calabria, where it grows spontaneously on the lower parts of the mountains. This tree affords the well known medicinal laxative substance termed *manna*. It is obtained by making a horizontal incision in the stem of the tree towards the end of July. The fluid gum is received into cups formed of the leaves of the maple, and conducted into them by the foot-stalks of the leaf, or by straws inserted into the incisions. The manna continues to exude from the wounds of the bole for about a month after the incision is first made†. The comparative merits and value of the other foreign species of ash mentioned below, remain yet to be proved by the British forester; and we shall here, therefore, only observe, that the white ash of North America, among those enumerated below, is the only species that at present is considered to approximate to, and rival the common ash in value. In New Brunswick and Canada it most abounds, and is most multiplied in the United States, north of the river Hudson. Its most favourable sites are the banks of rivers and the edges and surrounding acclivities of swamps; it there sometimes attains to eighty feet in height.

* Vide Gentleman's Magazine, 1785; Hunter's Evelyn; Withering's Arrangement of British Plants; Pennant's Tour, 1772, p. 29; Gilpin's Forest Scenery, Vol. II., p. 280; Martyn's Ed. Miller's Gard. Dict.; Art. Fraxinus.

† See Trans. Royal Soc., vol. lx.

*Timber or Forest Species.*

| ASH-TREE. | FRAXINUS. | Native of | Ft. |
|---|---|---|---|
| Common | *excélsior* | Britain | 70 |
| Entire-leaved | *simplicifólia* | —— | 30 |
| White American | *americána* | N.Amer. | 40 |
| Var. Black do. | *pubéscens* | —— | — |
| „ Red do. | *rúbra* | —— | — |

*Species for Ornament, &c.*

| | | | |
|---|---|---|---|
| Weeping | *excel.péndula* | Britain | 70 |
| Horizontal | „ *horizontális* | —— | |
| Erose-leaved | „ *erósa* | —— | |
| Striped bark | „ *striáta.* | —— | 30 |
| Walnut-leaved | *juglandifólia* | | |
| Aleppo | *lentiscifólia* | Aleppo | |
| Flowering | *órnus* | Italy | |
| Many-flowered | *floribúnda* | Nepaul | |
| Manna | *rotundifólia* | Italy | |
| Cloth-leaved | *pannósa* | N.Amer. | |
| Four-sided | *quadrangulâta* | —— | |
| Flat-seeded | *platacárpa* | —— | |
| Long-leaved | *longifólia* | —— | |
| Red-veined | *rubicúnda* | —— | |
| Green-branched | *víridis* | —— | |
| Cinereous | *cinérea* | —— | |
| Grey-branched | *álba* | —— | |
| Richards' | *Richárdi* | —— | |
| Sharp-leaved | *oxycárpa* | | |
| Elder-leaved | *sambucifólia* | N.Amer. | |
| Silver-leaved | *argéntea* | Corsica | |
| Elliptic-leaved | *elliptica* | N. Amer. | |
| Oval-leaved | *ováta* | —— | |
| Mexican | *mexicána* | Mexico | |
| Dotted-stalked | *epíptera* | N. Amer. | |
| Red-veined | *rubicúnda* | —— | |
| Powdered | *pulverulénta.* | —— | |
| Mixed | *mixta* | —— | |
| Expanded | *expánsa* | —— | |

## ELÆAGNEÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| OLEASTER-TREE. | ELÆAGNUS. |

*Tetrandria Monogynia. Linn.*

*Calyx*, four-cleft, bell-shaped; *corolla*, none; *drupe*, inferior; *seed*, a nut, oblong, obtuse.

*Time of sowing seed*—Autumn: may be sown in pots or propagated by layers. *Soil*—A sandy loam is what it affects most. *Uses*—It is admired for the fragrance of its foliage. The comparative value of its wood has not yet been proved.

*Species for Ornament, &c.*

| OLEASTER-TREE. | ELÆAGNUS. | Native of | t. |
|---|---|---|---|
| Narrow-leaved | *angustifólia.* | S. Europe. | 18 |

URTICEÆ. *Nat. Syst.*

| Eng. Name. | Bot. Name. |
|---|---|
| MULBERRY-TREE. | MORUS. |

*Monœcia Tetrandria. Linn.*

MALE FLOWER—*calyx*, four divisions; *corolla*, none. FEMALE FLOWER—*calyx*, four-leaved; *corolla*, none; *style*, two; *seed*, single, ovate, acute, covered by the calyx, which ripens into a large fleshy berry.

*Time of sowing seed*—March, in light earth, with gentle artificial heat; or propagate by layers. *Soil*—It flourishes best on a rich sandy loam; but it will thrive even on very sandy soils, if of proper depth. *Uses*—The black mulberry is chiefly cultivated for its fruit, and the white mulberry for its leaves, which are considered the best food for the silk-worm: It has been long ago recommended that, instead of pulling the leaves off singly for the food of the silk-worm, they should be shorn off, together with their young branches, by which the tree is much less injured.

*Timber or Forest Species.*

| MULBERRY-TREE. | MORUS. | | |
|---|---|---|---|
| Common | *nigra* | Italy | 30 |
| Red | *rúbra* | N.Amer. | — |

*Species for Ornament, &c.*

| | | | |
|---|---|---|---|
| White | *álba* | China | 20 |
| Paper | *papyrífera* | Japan | |

| LOTE or NETTLE-TREE. | CELTIS. |
|---|---|
| *Polygamia Monœcia. Linn.* | |

BISEXUAL FLOWER—*calyx*, five-parted; *corolla*, none; *stamina*, five; *styles*, two; *drupe*, one-seeded.

MALE FLOWER—*calyx*, six-parted; *corolla*, none; *stamina*, six; *seed*, a nut, roundish.

| LOTE or NETTLE-TREE. | CELTIS. | | | |
|---|---|---|---|---|
| European Nettle-tree | *austrális* | S.Eu. | 20 to 40 | |
| Eastern | *orientális* | Levant | — | |
| American | *occidentális* | N.Am. | — | 50 |
| Willdenow's | *Willdenowiána* | China | — | — |
| Chinese | *sinénsis* | — | — | — |
| Tournefort's | *Tournefórtia* | Levant | — | — |

*Time of sowing the seed*—March, or, if it can be procured in time, sow in the autumn, in a mixture of peat and loam, placed in pots or boxes, sheltered from the frost, and shaded in hot weather from the sun. These trees require protection for the first two years, or while young; afterwards they may be planted in any moderately exposed situation. The soil best adapted to them is a sandy loam. *Uses*—the wood of the European nettle-tree is considered to be one of the hardest; and Evelyn says, that in former times it was used for the manufacture of musical instruments. The American nettle-tree is similar in its foliage and general appearance to the European species; the branches of both are numerous and slender, and the limbs take their rise at a small distance from the ground, and grow in a horizontal or an inclined direction. Michaux observes, that the comparative value of the wood has not been proved in America, but that it is similar in properties to the former species. As yet those other species enumerated above are considered as merely ornamental.

| Eng. Name. | Bot. Name. |
|---|---|
| ELM-TREE. | ULMUS. |

*Pentandria Digynia. Linn.*

CALYX—five-cleft, inferior, permanent; *corolla*, none; *seed-vessel*, compressed, flat, one-seeded; *seed*, roundish, slightly compressed.

*Time of sowing the seed*—As soon as ripe in May, on a bed of fresh loamy earth to be shaded from the mid-day sun, until the plants appear to be well rooted. The Wych elm is almost the only species raised from seed; the other species are raised by layers. The American elms produce seed, but it seldom retains its vegetative powers long enough to be brought to England. A deep loam grows the elm to the greatest perfection. *Uses*—The wood is hard and tough, and resists the effects of moisture better than most other kinds of wood. Its tenacious adhesive quality renders it valuable for many important purposes, keels of ships, naves of wheels, &c.

| ELM-TREE. | ULMUS. | Native of | Ft. | |
|---|---|---|---|---|
| English | *campéstris* | Britain. | 80 | 100 |
| Cork-barked | *suberósa* | — | — | — |
| Dutch cork-barked | *májor* | — | — | — |
| Wych | *montána* | — | — | — |
| Smooth | *glábra* | — | — | — |
| Pendulous, or weeping | *pendulína* | — | — | — |
| American | *Americána* | N.Am. | — | — |
| White Hungarian | *álba* | Hung. | — | — |
| Curled | *crispa* | N.Am. | — | — |
| Dwarf | *púmila* | Siberia | — | — |
| Slippery | *fúlva* | — | — | — |
| Chichester | *vegéta* | N.Am. | — | — |
| Winged | *aláta* | — | — | — |

There are new varieties of the elm of recent introduction, as the Huntingdon, Chichester, fan-leaved, &c. These exhibit a more rapid and luxuriant growth than the other species mentioned; but their comparative value, as regards the quality of the timber, has not yet, as far as we know, been satisfactorily determined. There is a difference of opinion as respects the comparative value of the wych and the English elms. The weight of opinion is in favour of the English elm, *ulmus campestris*. The corked barked elm is held on all hands to be very inferior, particularly the Dutch species. Where hedge-row timber is at all admissible, the elm is perhaps of all other trees the most to be preferred. The practice of lopping and *pollarding* these trees sadly disfigures the general appearance of the country where it is practised to any extent, and the timber of such pollards is almost always found defective. The wych elm attains to a great size; Marshall (on Planting, vol. ii.) mentions a tree of this kind near Bradley church, in Suffolk, which, in 1754, measured twenty-five feet five inches in circumference, and in thirteen years after measured twenty-six feet three inches, at five feet from the ground.

### AMENTACEÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| WILLOW-TREE. | SALIX. |

*Diœcia* 1, 2, 3, 5, *Andria. Linn.*

*Calyx*, aments composed of scales; *corolla*, none. In the MALE FLOWER, the nectary consists of a melliferous gland; in the FEMALE FLOWER, the style is bifid. *Seed*—*vessel* or capsule one-celled, two-valved, downy, numerous, ovate, very small.

*Time of sowing seed*—March; but generally propagated by cuttings or sets in the spring. *Soil*—Moist soils of almost every description will suit this tree. *Uses*—The osier (*salix viminalis*) affords the materials of the basket-maker; also binders, thatching-rods, rakes, scythe-handles, &c. The other species enumerated, but especially the *Salix Russelliana*, which is perhaps of more rapid growth than the rest, affords poles and rails, and is made use of for a great variety of other purposes. The bark of the *sálix álba*, Doctor A. T. Thompson observes, supplies the place of the Peruvian bark, in the case of intermittent fevers. It owes its efficacy to a peculiar alkaline principle which has been termed *salicina*, and which can be separated from the other components of the bark.

*Timber or Forest Species.*

Species, with subserrate villose leaves.

| WILLOW-TREES. | SALIX. | Native of | Ft. |
|---|---|---|---|
| Common white | *álba* | Britain | 40 |
| Ash-coloured | *cinérea* | —— | 20 |
| Osier (bushy) | *viminális* | —— | |
| Round-leaved | *cáprea* | —— | 30 |

Species with leaves smooth, serrate.

| | | | |
|---|---|---|---|
| Long-leaved triandrous | *triándria* | Britain | 30 |
| Peach-leaved | *amygdalina* | —— | — |
| Duke of Bedford's | *Russelliána* | —— | — |
| Sweet, or bay-lvd. | *pentándria* | —— | |
| Crack | *frágilis* | —— | 15 |
| Halbert-leaved | *hastáta* | —— | — |
| Rose | *hélix* | —— | — |
| Golden | *vitellina* | —— | — |
| Weeping | *babylónica* | —— | 40 |

| Eng. Name. | Bot. Name. |
|---|---|
| POPLAR. | POPULUS. |

*Diœcia Octandria. Linn.*

*Calyx* of the ament, a flat scale, torn at the edge; *corolla*, turbinated, oblique, entire; *stigma* of the FEMALE FLOWER, four-cleft; *seeds*, many, ovate, furnished with capillary pappas, which act as wings to carry the seeds by the wind, enclosed in a one-celled capsule.

*Time of sowing seed*—Propagated by cuttings, suckers, and layers; the first mode preferred. *Soil*—It affects a moist soil, but will grow in almost every description of soil. *Uses*—The chief use of the wood of the forest species is for the turner in the manufacture of trays, bellows, and various domestic utensils. The wood of the Abele poplar is found to be very useful for water-works, having been proved to keep sound for a long series of years when so used*.

The common grey poplar is sometimes confounded with the abele or white species. The leaves of the former are smaller and rounder shaped, and but little cottony underneath, sometimes smooth. The bark of the stem becomes of a beautiful silvery grey hue. This species is of slower growth, but,

* Notwithstanding the general disrepute of the wood of the Lombardy poplar for out-door works, there are instances of its durability being proved, in making close palings, when well saturated with coal-gas tar.

in time, becomes a handsome tree, with the branches of the top more compact than in that of the abele. The leaves of the abele are densely cottony underneath, as are also the young shoots and footstalks of the leaves. The root is powerfully creeping, which unfits the tree to be planted in fields where pasturage or tillage exists. The creeping roots send up suckers, used in propagating the tree. Layers are also used, as well as cuttings of the branches, for the same purpose. It having been doubted whether this or the former was the true abele of the Dutch, where in Holland the abele is highly valued, we procured specimens from a celebrated grower in that country, and these proved, beyond a doubt, that the abele of Holland is the *Populus alba*, or abele of Britain, and not the *Populus canescens*, or grey poplar. The value of this tree, in peaty and low damp soils, is well worthy the attention of the forest-tree planter. Besides the uses of the wood before remarked, it is considered good for wainscoting, floors, laths, and packing cases, indeed, from the boards of it not splitting by, but closing on, the heads of nails, it is considered superior to deal for the latter purpose. The wood of the Lombardy poplar is held in esteem for the like purpose. The bark of the abele is recommended in the cure of intermittent fevers. It should be gathered in summer, when full of sap, and dried by a gentle heat. When powdered, a dram of it is given every four hours between the fits. A white poplar in St. John's College Walks, Cambridge, blown down in a hurricane, Nov. 6, 1795, was forty-two feet in length, and nine feet ten inches in circumference, which, with the limbs, gave 328 cubic feet of timber.

The black Italian poplar attains to a large size in a comparatively short space of time, as is proved at page 89. It delights in moist situations, but grows fast in almost every kind of soil. It is a more valuable tree than the Lombardy poplar, and for upland soils superior to the abele. The timber is used for the like purposes as those of the former. The property of slow combustion seems general in the wood of all the different species of poplar, and this property, which renders the wood valuable for floors and internal works in buildings in case of accidents by fire, renders it of inferior value for fuel.

The aspen, aspe, or trembling poplar, attains to a large size and succeeds well in almost every description of soil, except clay. The roots are very impoverishing to the land, and the aspen is, therefore, confined to local sites. The well-known property of being moved by the slightest current of air possessed by the leaves of this tree, appears to originate in the structure of the petiole, or footstalk of the leaf, the planes of which (being a compressed petiole) are at right angles to those of the body of the leaf, which is itself furnished with two glands, running one into the other. Such are the opinions of Linnæus and of Dr. Stoke regarding this point. But the flattened footstalk is common to all the poplars with which we are acquainted, and all are more or less subject to have the leaves easily put in motion; in fact the structure of the petiole, as now described, will readily explain the matter to the observer, and that in proportion to the length and slender structure of a petiole so constituted to that of the body of the leaf, depends its sensibility of any cause of motion. Lightfoot mentions, that this almost constant trembling of the leaves of the aspen had given rise to a superstitious opinion in some parts of the Highlands of Scotland, that our Saviour's cross was made of the wood of this tree, and that therefore its leaves could never rest.

Among the North American species of poplar, the Canadian (*monilifera*) offers great merits, as far as experience in its culture in Britain affords the means of drawing satisfactory conclusions. It affects a moist, deep, rich soil; such are fertile peat and alluvial soils. Mr. Hursthouse of Tydd, near Wisbeach, planted trees of the *Populus monilifera*; in 1822, and nine years after he had trees of a size to saw into scantlings, which, for toughness of texture, his carpenter stated to exceed any he had before met with. This species is more nearly allied to the *Pópulus angulàta*, or Canada poplar, than to any other species. The Canada poplar is distinguished at first sight by its angular branches. These arise from the lower side of the

base of each footstalk, one from the centre of the base, and one from each side of it. The leaves being arranged alternately on the shoot, and these angles or wings falling or proceeding from the base of each, and terminating at or just before they reach the next bud, or leaf, form five angles of the shoot. When a shoot is divided, the pith exhibits five angles, corresponding to these nerves of the leaf-stalk. A similar arrangement takes place on the shoots of the Canadian poplar, with this exception, that the angles are seven in number instead of five; they are also much less prominent. The botanical characters are specifically distinct; but as these are not often within the reach of the inquirer, the above may be found useful in distinguishing these two species, often confounded together. The magnificent broad shining leaves of the Carolina poplar, with the peculiar habit alluded to, its rapid growth, and general appearance, when advanced to the size of a timber tree, render it well worthy a place in sheltered glades of plantations. The lower part of Virginia, Michaux informs us, is the most northern point at which this species is found in America, it being more common in the two Carolinas, in Georgia and Lower Louisiana, on the marshy banks of the great rivers, where it attains to eighty feet in height, with a proportional diameter. He terms the Canadian poplar *Pópulus Canadénsis*: and he gives our *monilifera* to another species, having a smooth cylindrical stem, but similar to the *Pópulus lævigáta*. He calls our Canadian poplar cotton-wood, and states that it rises to seventy or eighty feet in height, and three or four feet in diameter; and it is preferred as a useful tree. The Ontario, or smooth-leaved poplar, may rank next in order to those just now mentioned, for rapidity of growth and beauty of its foliage. The comparative value of its timber remains to be determined by time. Those other species enumerated below are all deserving of a place in plantations to prove the comparative value of each.

*Timber or Forest Species.*

| POPLAR. | POPULUS. | Native of | Ft. |
|---|---|---|---|
| Com. grey, suc. | *canéscens* | Britain | 40 |
| Black, suc. cut. | *nigra* | —— | 30 |
| Lombardy, cut. | *dilatáta* | Italy | 70 |
| Balsam „ | *balsamifera* | N.Amer. | 40 |
| Athenian „ | *Gréca* | Greece | — |
| Canadian „ | *monilifera* | N.Amer. | 30 |
| Aspen „ | *trémula* | Britain | 50 |
| Abele-tree, suc. | *álba* | —— | 40 |

*Ornamental Species.*

| POPLAR. | POPULUS. | Native of | Ft. |
|---|---|---|---|
| Carolina, lay. | *angulàta* | N.Amer. | 40 |
| Heart-leaved „ | *cándicans* | —— | 20 |
| Various-leaved „ | *heterophýlla* | —— | — |
| Smooth-leaved „ | *lævigáta* | —— | 30 |
| Weeping „ | *péndula* | —— | — |
| Trembling „ | *trépida* | —— | — |
| Large-dented „ | *grandidentata* | —— | — |
| Laurel-leaved „ | *laurifólia* | Altay. | — |
| Slender-twigged „ | *viminea* | N.Amer. | — |

(*Subordo, Betulinæ.*) *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| ALDER-TREE. | ALNUS. |

*Monœcia Tetrandria. Linn.*

MALE FLOWER—*receptacle* of the ament, wedge-shaped, truncated, composed of three flowers; *calyx*, scaly; *corolla*, four-parted; *stamina*, four. FEMALE FLOWER—Ament *calyx*, scaly, or two-flowered; *corolla*, none; *seed*, compressed, oval, naked.

*Time of sowing seed*—Autumn or spring: if left until spring, preserve them in dry sand. *Soil*—Moist or damp soils are the most fit for the growth of the alder. *Uses*—This tree is the most valuable of the sub-aquatic forest-trees. The wood (see p. 9, fig. 1.) is esteemed for under-water-work, as piles, pipes, pumps, sluices, &c. The charcoal made of its wood is highly valued for the manufacture of gunpowder. The bark and young shoots afford a yellow dye, and also afford a basis for black colours.

Besides the uses just mentioned of the wood of the common alder, the roots and knots furnish a valuable material for cabinets, this part of the wood being often beautifully veined. The bark is used by dyers, tanners, and leather dressers, and for tanning nets. An ounce of the bark powdered and boiled in three-fourths of a pint of water, with an equal quantity of logwood and solution of copper, tin, and bismuth, six grains each, and two drops of solution of sulphate of iron, will dye a strong deep *boue de Paris*. The Laplanders are said to chew the bark, and dye their leathern garments with their saliva. The shoots cut in March are said to dye a fine cinnamon colour and a handsome drab or tawney when previously dried and

powdered. The value of the charcoal in the manufacture of gunpowder is well known.

Linnæus says that horses, cows, sheep, and goats eat it, but that swine refuse it. The tongues of horses feeding upon it are said to turn black during its use. It is very astringent, and most probably unwholesome to animals as food. In low damp situations, by the sides of streams, &c., it makes the best hedges, as it grows in such situations freely, where the thorn or quick will make little or no progress. In damp situations it is an useful coppice wood. The economical properties of the varieties of the common alder enumerated below have not hitherto been proved; they are ornamental, and deserving of a position in the damp margins of woods.

The American species are considered to be inferior to the common alder as regards the uses of the wood and the bark; nor as yet are there any proofs of the comparative value of the Siberian and European species, beyond that of giving variety to the effects of foliage in plantations.

*Timber or Forest Species, and for Ornament, &c.*

| ALDER-TREE | ALNUS | Native of | Ft. |
|---|---|---|---|
| Common | *glutinósa* | Britain | 25 |
| Var. Silver-striped | *fóliis argénteis* | —— | — |
| „ Emarginate | *emarginátа* | —— | — |
| „ Cut-leaved | *incisa* | —— | — |
| „ Jagged-lvd. | *laciniáta* | —— | — |
| „ Oak-leaved | *quercifólia* | —— | — |
| „ Oblong-lvd. | *oblongáta* | S. Europe | — |
| „ Elliptic-lvd. | *elliptica* | —— | — |
| Hoary-leaved | *incana* | Europe | — |
| Var. Angular-leaved | | —— | — |
| „ Winged | | —— | — |
| Broad-leaved | *macrophýlla* | —— | — |
| Siberian | *Siberica* | Siberia | — |
| Saw-leaved | *serruláta* | N. Amer. | — |
| Wave-leaved | *unduláta* | Canada | — |
| Glaucous | *glaúca* | N. Amer. | — |
| Red | *rúbra* | —— | — |
| Dwarf | *púmila* | —— | — |
| Heart-leaved | *cordifólia* | —— | — |

| Eng. Name. | Bot. Name. |
|---|---|
| BIRCH-TREE. | BETULA. |

*Monœcia Polyandria. Linn.*

ALE FLOWER—scales of the *ament*, imbricated, shield-shaped, and three-flowered; *calyx*, one scale; *corolla*, none; *stamina*, ten to twelve. FEMALE FLOWER—*ament*, imbricated; scales of the *calyx*, two-flowered; *corolla*, none; *seed*, one, winged.

*Time of sowing seed*—Autumn or spring; to be kept in dry, cool sand, from the time it is ripe until it is sown. *Soil*—The birch will grow in every description of soil, from the wettest to the driest. *Uses*—The wood is chiefly used by the wheelwright and turner; it affords good charcoal; its soot is esteemed as an ingredient in printers' ink; the bark is of use in dyeing wool yellow; but the chief use of the tree is for underwood. The spring sap of the birch-tree has a saccharine quality, and is sometimes made into wine. The weeping birch is a very ornamental plant.

The common birch is found in the highest latitude or limits of the growth of trees. In the 70th degree of north latitude, its stature is reduced to that of a shrub, and it is singular that the opposite extreme of a warm or dry atmosphere has a similar effect in preventing its growth. Michaux assumes the 45th parallel as the limit below which the common birch is only accidentally found in forests, unless on high elevated sites where the temperature is sufficiently low. Although the merits of the wood of the birch will not allow of its ranking as one fit for planting on soils where the more valuable forest-trees will attain to due perfection of growth, yet for certain poor elevated soils it is highly valuable, and on very wet or springy land it will be productive; there are instances known of its produce on soils so poor as scarcely to carry any thing else but moss, affording in ten years growth the value of ten pounds per acre. In the northern parts of Europe it attains to seventy feet in height, and two feet in diameter. In Sweden, Norway, and Finland the inhabitants avail themselves of its wood, bark, leaves, and sap, for a great variety of economical uses, for almost all the implements of husbandry, elegant articles of furniture, for bowls, plates, spoons, chairs, &c. The bark is used for the manufacture of boxes, baskets, and sandals; its durability is so great that it is used in preserving parts from decay by wrapping it round them. The Laplanders prepare the skin of the rein-deer with the bark. They cut the bark into small pieces, which they macerate, and afterwards boil in water, with the addition of a little salt. The skins are plunged repeatedly into this decoction warmed, and are allowed

to remain in it several days. They are then taken out, and rendered pliable and soft, and in this state they are scarcely permeable to water. In Russia, by slowly burning the bark in kilns, an empyreumatic oil is obtained with which leather is prepared, highly esteemed for durability. Evelyn enumerates a great variety of uses to which the birch is applicable, and Lightfoot gives details of its uses in the Highlands of Scotland. In America, the black birch is considered the most interesting of the species of that country. In some parts of the United States, it goes by the name of black birch; in Virginia, mountain mahogany; and in Connecticut, sweet birch; and in Canada, cherry birch. In deep loose soils Michaux has observed some seventy feet high, and two to three feet in diameter. The habit of this species is admired for its foliage, and its odoriferous flowers. In the Annals of the Arts a stock of this species is stated to have attained the height of forty-five feet in nineteen years. It is highly deserving a place in British forests.

The white birch, as it is called in America, or *Bétula Populifólia*, seldom rises to more than twenty-five feet in height. The distinctness of its foliage is its only recommendation at present known, for its wood is considered of inferior quality. The red birch of Michaux, or the *Bétula lanulósa* of our list, is chiefly found in Maryland, Virginia, and the upper parts of the Carolinas and of Georgia; it is seldom found farther north than New York. The epidermis of the bark of trees not exceeding eight or ten inches in diameter, is of a red or cinnamon colour, but on large trees (it sometimes attains to seventy feet in height) the bark is of a greenish hue. The twigs of this species are considered superior to those of any other species for the purpose of making brooms. The paper birch is considered by some to surpass the common species in size and value of its wood. In Canada, and the district of Maine, the country people place large pieces of the bark immediately below the shingles of the roofs of their houses, as it forms a lasting and very impenetrable barrier to the rains. Various articles are manufactured of it, such as portfolios, &c. which are sometimes embroidered with silk of different colours. When divided into very thin sheets, it forms a substitute for writing paper; but the most important use, Michaux observes, to which it is applied, is in the construction of canoes. To procure proper pieces of the bark for this purpose, the largest and smoothest boles are selected. In the spring two circular incisions are made several feet apart, and two longitudinal ones in opposite sides of the hole; after which, by introducing a wooden wedge, the bark is easily detached. These plates are usually ten or twelve feet long, and two feet nine inches broad. To make the canoe, they are stitched together with fibrous roots of the white spruce, about the size of a quill, which are deprived of the bark, split and made supple by immersion in water. The seams are coated with resin of the balm of Gilead fir. Great use is made of these canoes by the natives and French Canadians in their long journies into the interior of the country—they are very light, and are easily transported on the shoulders from one lake or river to another. A canoe calculated to carry four persons, with their baggage, weighs from 40 to 50lbs.—some of them are made to carry as many as fifteen persons*. Upon the whole, this species appears to be well worthy the attention of the British forest-planter of certain descriptions of soil. Of the other species of birch enumerated below, the last seven are of dwarf stature, and fit only for cover, or for the margins of woods; at least the experience that has as yet been had of their culture does not warrant any further recommendation of them at present; but with these, as with numerous other species of trees, extended experience, and careful observation of their properties, and most suitable soils, are wanted, before satisfactory conclusions can be arrived at, as to their relative or comparative values.

*Timber or Forest Species.*

| BIRCH-TREE. | BETULA. | Native of | Ft. |
|---|---|---|---|
| Common..... | *álba*..... | Britain | 40 |

* North American Sylva, vol. ii., p. 88.

† The *Rhododéndron pónticum* is an instance to shew that a plant may be long known only for its ornamental properties. It was introduced into England in 1763, and it is only of late years that its value for underwood and cover, in sandy and peaty soils, has been discovered and taken advantage of.

| BIRCH-TREE. | BETULA. | Native of | Ft. |
|---|---|---|---|
| Var. Warted | *verrucósa* | —— | — |
| „ Weeping | *péndula* | —— | — |
| „ Palmate-lvd. | *dalecárlica* | —— | — |
| „ Eastern | *póntica* | Asia | |
| „ Large-fruited | *macrocárpa* | | |
| Pubescent | *pubéscens* | Europe | |
| Poplar-leaved | *populifólia* | N. Amer. | |
| Tall | *excélsa* | —— | |
| Woolly | *lanulósa* | —— | |
| Yellow | *lútea* | —— | |
| Black | *nigra* | —— | |
| Daurian | *davúrica* | Dauria | |
| Paper | *papyrácea* | N. Amer. | |
| Soft | *lénta* | —— | |
| Hornbeam-leaved | *carpinifólia* | —— | |
| Carpathian | *carpáthica* | Carpathian Mt. | |

*Species for Ornament, Shelter, &c.*

| | | | |
|---|---|---|---|
| Oval-leaved | *ováta* | Europe | |
| Alnus | *viridis decand.* | — | |
| Shrubby | *fruticósa* | Siberia | |
| Glandular | *glandulósa* | N. Amer. | |
| Hairy-dwarf | *púmila* | —— | |
| Smooth-dwarf | *nána* | Scotland | |
| Var. large-leaved | *macrophýlla* | | |
| Dark | *tristis* | Kamtschatka | |

| Eng. Name. | Bot. Name. |
|---|---|
| HORNBEAM-TREE. | CARPINUS. |

MALE FLOWER—*ament*, imbricated; scale of the *calyx*, ciliate; *corolla*, none; *stamina*, ten. FEMALE FLOWER—*ament*, imbricated; scale of the *calyx*, two-flowered; *corolla*, three-cleft; *seed*, a nut, ovate, angular, furrowed.

*Time of sowing the seed*—Autumn. *Soil*—Poor clayey loams, incumbent on sand, and chalky gravels, are well adapted for the growth of the hornbeam. *Uses*—The wood (see page 9, *fig. f*) of the hornbeam, as its name would imply, is extremely tough, or flexible, and hard, and valuable for many useful purposes; but the tree being chiefly cultivated for underwood, few opportunities are offered to the carpenter to prove its value in large scantling. Its value for every purpose where the properties above mentioned are essential, such as mill-clogs, heads of beetles, stocks and handles of tools, yokes, &c., is well-known. Like the beech, it is good fuel, makes superior charcoal, and affords excellent potash. It grows in exposed situations, and on very poor, cold, thin, damp soils, where many other species of forest-trees would make little progress. The leaves continue to adhere to the branches long after vegetation in them appears to have ceased. This property renders the plant valuable for the purposes of shelter, whether when singly planted or in rows, to be cut as a hedge. On soils of the nature mentioned, the hornbeam should always have a place, if not exclusively, at least in a considerable proportion to other species of trees. The varieties of the common hornbeam, mentioned below, are not otherwise interesting to the forest-planter than as regards the effect of foliage, and as subjects illustrative of the laws of vegetable economy.

The American hornbeam is found wild as far north as Nova Scotia, New Brunswick, and Lower Canada. By the French inhabitants of Upper Louisiana it is called *Charme*. It never exceeds thirty feet in height, and its more ordinary dimensions scarcely entitle it to rank as a timber tree. The trunk is similarly fluted as that of the foregoing species.

*Timber or Forest Species.*

BETULINÆ. *Nat. Sys.*

| HORNBEAM-TREE. | CARPINUS. | Native of | Ft. |
|---|---|---|---|
| *Monœcia Polyandria. Linn.* | | | |
| Common | *bétulus* | Britain | 30 |
| Var. Oak-leaved | *quercifólia* | —— | |
| „ Striped-leaved | *variegáta* | —— | |
| „ Cut-leaved | *incisa* | —— | 15 |
| American | *americana* | N. Amer. | 20 |

*Species for Ornament, &c.*

| | | | |
|---|---|---|---|
| Eastern | *orientális* | Levant | 12 |

| Eng. Name. | Bot. Name. |
|---|---|
| HOP-HORNBEAM. | OSTRYA. |

*Monœcia Polyandria. Linn.*

MALE FLOWER—*ament*, imbricated; *calyx*, one scale; *corolla*, none; *filaments*, ramose. FEMALE FLOWER—*ament*, naked; *calyx*, none; *corolla*, none; *capsule*, inflated, imbricated; *seed*, one at the base.

Propagated in England by grafting on the common hornbeam and by layers. *Uses*—The wood of the hop-hornbeam, or iron wood of America, is heavy, compact, and tough, and is used in America, Michaux informs us, for levers, brooms, and scrubbing brushes; the latter are made by rolling back very thin slices of the wood, adhering to a piece of suitable dimensions. In America it is considered a tree of the third order as to size, rarely exceeding thirty-five feet in height, and twelve or fifteen inches in diameter. It is never found in masses, but scattered

in the forests, and is more common near Lakes Ontario and Erie, than elsewhere. The Virginian or flowering hop-hornbeam attains to a greater height than the former, It is a more ornamental tree, the leaves being larger and of a finer tint of green; the value of the wood is similar to that now mentioned.

*Species for Ornament, &c.*

| HOP-HORNBEAM, OR IRON-WOOD. | OSTRYA. | Native of | Ft. |
|---|---|---|---|
| Common | *vulgáris* | Italy | 20 |
| Virginian | *virgínica* | N. Amer. | — |

CUPULIFERÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| HAZLE-TREE. | CORYLUS. |

*Monœcia Polyandria. Linn.*

MALE FLOWER—*ament*, imbricated; *calyx*, a scale; *corolla*, none; *stamina*, eight. FEMALE FLOWER—*calyx*, two-parted, lacerated; *corolla*, none; *styles*, two; *seed*, an oval nut, fixed in the calyx, which remains permanent.

*Time of sowing*—February: should be preserved in sand moderately dry, during the winter. If the fruit be an object, the best kinds must be propagated by layers. *Uses*—Underwood or coppice, which, being of under size, is applied to the purposes of making hoops, spars, forks, hurdles, withes, wattling, crates, &c., for which it is esteemed. It may be cut every seven years. Mr. Belcher, in Young's Annals, vol. viii. p. 186, mentions, that in Kent the best soil for the filbert is a strong loam, the fruit produced on which is large and not maggoty; and that an acre has sometimes been sold for 50*l.* They are generally planted at 12 feet apart, the intervening ground being occupied with green crops, the culture of which requiring the frequent use of the hoe, is productive of benefit to the filbert plant, which is kept pruned to the height of six feet, and the diameter of the bush thus formed to about the same dimensions. The Constantinople hazel attains to the size of a tree. It was introduced into England in 1665, by Mr. John Rea. Linnæus mentions a very large tree of it in the Leyden Garden, in 1736, sown there by Clusius, above a century before. It is too much neglected by planters in England. The raceme, or fruit-bunch, is very large in this species, and the individual nuts are twice the size of those of the common hazel.

*Species for Ornament, &c.*

| HAZLETREE. | CORYLUS. | |
|---|---|---|
| Common | *avellána* | Britain |
| Var. White filbert | *álba* | — |
| „ Red filbert | *rúbra* | — |
| „ Oval-fruited | *ováta* | — |
| „ Barcelona | *barcelonénsis* | Spain |
| „ Cobnut | *grándis* | Britain |
| „ Clustered | *glomeráta* | — |
| Lambert's | *tubulósa* | S. Europe |
| Dwarf American | *húmilis* | N. Amer. |
| Cuckold | *americána* | — |
| Common do. | *rostráta* | — |
| Constantinople | *colúrna* | Constan. |

CUPULIFERÆ (*subordo third*). *Nat. Sys.*

OAK-TREE. QUERCUS.

*Monœcia Polyandria. Linn.*

MALE FLOWER—*calyx*, bell-shaped, half fine-cleft; *corolla*, none; *stamina*, five to ten. FEMALE FLOWER—*calyx*, bell-shaped, entire, rough; *corolla*, none; *style*, one; *stigma*, three; *seed*, a nut (acorn), ovate, cylindrical, fixed in a short hemispherical cup.

*Time of sowing*—Beginning of November; or if deferred till spring, lay them upon a cool dry floor, to prevent their sprouting or vegetating. *Soil*—A rich loam, with a clayey subsoil, brings the oak to the greatest perfection; but it may be profitably cultivated on almost every description of soil, except boggy or peaty. *Uses*—The value of oak timber is too well known to need any description here. It has already been mentioned at p. 24, that there are two species or varieties of the British oak, *Quercus robur*, which differ considerably from each other in the value of their timber. They are considered by some botanists as merely varieties, *Quercus robur* pedunculata, et *Quercus robur* sessiliflora; while others, as Sir James Smith, makes them distinct species, *Quercus robur* et *Quercus sessiliflora*. The footstalks of the fertile *flowers*, *acorns*, and *leaves*, afford the most obvious character of distinction: in the former or more valuable variety, the footstalks of the flowers and acorns are longer, while in the inferior variety the footstalks are very short, or scarcely perceptible. On the contrary, as regards the *leaves*, the footstalks of the *Quercus robur* are shorter than in those of the *Quercus sessiliflora*, and the body of the leaf is likewise

less equally and regularly divided. The Durmast oak, *Quercus pubescens*, has been considered a variety also, but having an inferior quality of wood, it is perhaps better to consider it a distinct species. The distinguishing character of this species is in having the under side of the leaf pubescent; in other respects it nearly agrees with the *Quercus sessiliflora*, in having the leaf and fruitstalks almost sitting, and the leaves less deeply indented. The leaves of the inferior species are also observed to hang longer on the tree; sometimes they continue all the winter, approaching towards the character of an evergreen. This last distinction, however, is not always to be depended on, as the soil and health of the individual tree influence its habit in this respect. In our own experience we have by no means found this inferior species, *Quercus sessiliflora*, and its near ally to the Durmast oak, *Quercus pubescens*, so common as the foot-stalked oak, *Quercus robur*; but, on the contrary, comparatively uncommon. Although there are not such clear and specific facts recorded of the comparative difference of value between the quality of these two species of oak, as to determine the exact amount of loss which is occasioned every time the acorns of the inferior species are used for planting, instead of those of the more valuable above mentioned, yet the general opinion being so strong in favour of the superiority of the foot-stalked oak, that it is of much importance to collect and sow the acorns of that species only*. We have already, at p. 23, 24, 25, described the mode of rearing the oak from the acorn on the spot where it is to remain for the production of timber; the soil on which it attains to great perfection (p. 49), and the best size of plants, from nursery rows, when the more general mode of rearing oak by transplanting is adopted (p. 34.) We have before also mentioned some oak trees remarkable for the perfection of growth they had attained; and did the limits of these pages permit, we could add greatly to the number from specimens which were, or are now in Earl Powis's Park, near Ludlow; Earl of Surrey's, Worksop; Lord Bagot's in Staffordshire; Lord Holland's, Ampthill Park*, Bedfordshire; Withy Park, Shropshire, Dennington Park, Berkshire, in the weald of Kent, New Forest, Hampshire, &c. These two species of oak constitute a considerable portion of the forests, from the sixtieth to the thirty-fifth degree of north latitude, extending over a portion of the north of Asia, and the northern point of Africa.

The common oak is considered to be the longest lived tree of the British forests. Those in the New Forest, mentioned by Mr. Gilpin in his Forest Scenery, v. ii. p. 63, which 'chronicle on their furrowed trunks, ages before the Conquest,' give an idea of the very great length of existence this species of tree is capable of maintaining; but for facts, on which to found a satisfactory conclusion of the average duration of vegetable life in this, and other forest-trees, we have only the test mentioned at p. 5, that of ascertaining the number of the concentric circles in the transverse section of the root, stem, or branch of the tree, and how-

* The specific botanical characters are, according to Sir J. Smith, as follows:—'*Quercus robur*—*Leaves*, deciduous, oblong, wider towards the extremity; their sinuses rather acute; lobes obtuse. *Fruit-stalks*, elongated.'—'*Quercus sessiliflora*—*Leaves* on elongated stalks, deciduous, oblong, with opposite acute sinuses. *Fruit*, sessile.'—Engl. Fl. p. 149—150.

The above discriminating characters are, according to our experience, as clear as the nature of the distinctions described will admit, but scarcely sufficient to constitute species.

* The circumference of one of these oaks at its base measures upwards of 40 feet, at its mean height about 30 feet: it is nearly hollow, and exhibits a concavity apparently sufficient to contain four or five middle-sized persons standing together withinside. The branches have been of very large dimensions, and one that still remains is equal in size to many a parent oak. The age of this tree must be very great, but the loss of the central wood will prevent the period of its age or duration being ascertained; and we believe there are no records of the planting of these oaks otherwise to determine this interesting point. The following lines are inscribed on a plate affixed to this remarkable oak:

Majestic tree! whose wrinkled form hath stood,
Age after age, the Patriarch of the wood;
Thou who hast seen a thousand springs unfold
Their ravel'd buds, and dip their flowers in gold,
Ten thousand times yon moon relight her horn,
And that bright star of evening gild the morn;—
Gigantic oak! thy hoary head sublime
Erewhile must perish in the wrecks of time.
Should round thy head innocuous lightnings shoot,
And no fierce whirlwind shake thy steadfast root,
Yet shalt thou fall; thy leafy tresses fade,
And those bare, scatter'd antlers strew the glade:
Arm after arm shall leave the mould'ring bust,
And thy firm fibres crumble into dust.
The Muse alone shall consecrate thy name,
And by her powerful art prolong thy fame;
Green shall thy leaves expand, thy branches play,
And bloom for ever in th' immortal lay!

ever satisfactory this test may be for this important object, it is but too seldom employed, if we are to judge by the few records of the ages of valuable trees, not only of the oak, but of all others of the first class of timber that are to be found. Were records of planting kept in the family archives of those who plant; containing the facts of the age of the plants, when transplanted to their timber sites, the nature and preparation of the soil at the period of planting, and the after culture until the trees attained to a timber size, the benefit to science and to practice would be great. (See note, *p. 11.)

The Turkey oak, *Quércus cérris*, was introduced into England in 1739. It is a handsome growing tree, and is perhaps the most valuable species next to the British oak. It will thrive on most kinds of soil; but a strong loam is that which it most affects. The wood exhibits all the good properties of that of the common oak; but the period of its introduction into England has not allowed of any sufficient trial to determine its comparative durability. It is highly deserving of a place in every plantation of forest-trees, where the soil is adapted to the growth of the oak, elm, and chestnut. The acorns are oblong, and the cup mossy. The leaves are deciduous, and readily distinguished from those of the common oak by their ovate-oblong shape and slightly flat sinuate margins.

Michaux informs us, that there are forty-four species of oak found in America between the 20th and 48th degree of north latitude: of these he has described and figured twenty-six species*, which are all interesting for their different habits of foliage and growth; for general utility, however, there appears to be not one equal to our own native species, *Quercus robur*. The white oak before noted approximates nearer in valuable properties to the British oak than any other. In favourable situations it rises to seventy or eighty feet in height, and six or seven feet in diameter. To inquiries made to English, French, and American shipwrights, this intelligent author learnt that the general opinion agreed in the conclusion, that European oak was tougher and more durable from the superior closeness of its grain, but that the American species was more elastic, and required a shorter time, and only half the weight to bend it; and he judiciously adds, that this advantage, though important in ship-building, does not compensate for the openness of its pores. In America it is much used in the construction of mills and dams, where it is exposed to be alternately wet and dry. The wooden bridge—nearly three thousand feet long, that unites Boston and Cambridge—is supported by posts of white oak, from sixteen to twenty feet in length, which have replaced those of white pine, on which it originally stood.

The American mossy-cup oak has the lobe of the leaves so deeply indented as to give them the appearance of pinnate-leaves. The branches of the first and secondary limbs have a pendulous habit, which, with its generally handsome top, claims for this species a place in plantations. The quality of its timber has not been proved in England. In America it attains to sixty or seventy feet in height.

The over-cup white oak is distinguished for the largeness of the leaves. In

* His arrangement is as follows:—First, fructification annual, with lobed leaves.
White-oak.....*quércus álba.*
European oak.....*róbur.*
European white oak...*róbur pedunculáta.*
Mossy-cup white oak..*olivæfórmis,*
Over-cup oak .....*macrocárpa.*
Post oak .....*obtusilóba.*
Over-cup oak .....*lyráta.*
Second:—Leaves toothed.
Swamp-white oak .....*discolor* vel *Michausii.*
Chestnut-white.....*palústris.*
Rock-chestnut.....*montana* vel *montícola.*
Yellow oak .....*acumináta* vel *castánea.*
Small chestnut oak....*prínos* vel *prinoides.*
Division 2d. Fructification biennial; leaves mucronated, except the thirteenth species.
Section first—leaves obtuse or entire:—
Live oak.....*vírens*
Cork oak .....*súber.*
Willow-leaved.....*phéllos.*
Laurel .....*imbricária* vel *laurifólia.*
Upland .....*cinerea.*
Running .....*púmila.*
Section second—leaves lobed:—
Bartram oak.....*heterophylla.*
Water oak.....*aquática.*
Black oak .....*nigra* vel *ferruginea.*
Bear oak.....*Banistéri.*
Third section—leaves multifid, or many cleft:—
Barren-scrub oak .....*quércus Catésbæi.*
Spanish oak .....*falcáta.*
Black oak .....*tinctória.*
Scarlet oak.....*coccinea.*
Grey oak .....*ambígua.*
Pin oak .....*palústris.*
Red oak.....*rúbra.*

the United States they are found to measure frequently fifteen inches long and eight broad. The acorns are large, and the lips of the cup are frequently fringed with a series of flexible filaments. This tree is also deserving of a place in British plantations.

The lobed-leaved, or post oak, is a tree of a secondary size. Michaux states, that the preference given in the West Indies to the staves from Baltimore and Norfolk is due, in a great measure, to their being made of the wood of this species. It is an ornamental tree, but its merits for the produce of timber have not yet been proved in England.

The over-cup oak, or lyre-leaved, affects a moist soil, and is of a large habit of growth. The shape of the leaves and general habit of the tree render it interesting. It has not yet received in England the requisite time and culture to prove its properties for the produce of timber. In America Michaux states its height to be eighty feet, and its circumference eight to twelve feet.

The swamp oak, *Quércus díscolor*, is much less common in America than many of the other oaks. We have seen only one plant of it in England. Michaux describes it as a beautiful tree, more than seventy feet high; the leaves six or eight inches long and four broad, smooth and of a dark green above, and downy underneath. We believe this species to be nearly allied to the British durmast oak, *Quércus pubéscens*.

The chestnut white, or marsh oak, *Quércus Michaúxii*, is considered to be one of the most majestic trees of the American forests. It is described, according to the above, as rising to ninety feet in stature, with a straight clear stem of fifty feet, crowned with an expansive summit. The timber of it is considered inferior to the white oak, though superior to some other species. We have seen young trees only of it in England.

The rock chestnut leaved yellow oaks are as yet only distinguished for the shape of their leaves, which more or less resemble those of the sweet chestnut. The last mentioned is considered the most interesting. The acorns are of an inferior size, but of a sweeter quality than those of the other species mentioned. The small chestnut oak rarely exceeds thirty inches in height, and ought perhaps to have been passed over here without notice; however, it is very prolific, and where acorns are in request for the food of game, pheasants for instance, this dwarf oak may be planted with advantage. The acorns are very sweet. 'Of its habits in its native soil,' Michaux remarks, that 'Nature seems to have sought a compensation for the diminutive size of this shrub in the abundance of its fruit; the stem, which is sometimes no bigger than a quill, is stretched at full length upon the ground by the weight of its thickly clustering acorns.'

The live oak, *Quércus vírens*, was mentioned at p. 45,* as highly deserving of a trial in situations on the southern coast. Michaux remarks, that it is never found farther than from fifteen to twenty miles from the shore. The eminent success of Mr. Lucas in transplanting trees of large growth of this species selected from the woods, on his estate at Middleburg, prove clearly its vivacious habits. It appears to be confined to the southern states of North America, *viz.* the Floridas and Louisiana, as its natural soil and climate, extending no farther north than Norfolk in Virginia. He further mentions, that in the course of four or five hundred miles between Cape Canaveral in East Florida, to Savannah in Georgia, he frequently saw it on the beach, or half buried in the movable sands on the downs, where it had preserved its freshness and vigour, though exposed during a long lapse of time to the fury of the wintry tempest, and to the ardour of the summer's sun. Its usual height in its native soil is from forty to forty-five feet, and one foot in diameter. The leaves are evergreen. The wood is extremely hard, tough, and very lasting. It is used for ship-building, screws, cogs for mill wheels, and other purposes, for all which it is preferred to the white oak.

The cork-tree, or cork oak, is a native of the south of Europe; it was introduced into England about ninety or a

* We here beg to correct a passage by inserting an omission at page 45, line 18 from the top; after the words, 'the live oak will not exist in England,' add, '*in elevated exposed situations*.'

hundred years ago*. It is found growing naturally in the south of France, in Spain, Portugal, and in some parts of the states of Barbary. It rarely exceeds forty feet in height and three feet in diameter. The wood is considered to be less durable than the common oak, although it is compact and heavy. Its growth in England is confined to warm sheltered situations. In exposed situations it cannot be reared. The largest we have seen in England is in the Royal Gardens, Kew, where its characteristic property, that of producing in perfection cork-bark, was, when we saw it a few years since, very evident and interesting. Abroad the cork is considered fit to be first taken from the tree when it reaches twenty-five years of growth, but this product is not of a quality to be used for better purposes. In ten years it is renewed, but it is not until the tree has attained to the age of forty-five or fifty years that the bark possesses all the requisite property for good corks. July and August are the seasons for taking it from the trees, which is carefully done, so as not to wound the alburnum; for should this happen (it may be unnecessary here to state), the cork bark is not again renewed on that part. The acorns should be sown as soon as received from abroad in small single pots, and shifted into larger as the roots increase, until the plants are from one to two feet high, when they may be transplanted for good; they may, however, be kept until they are six feet or more in height, provided care be taken to prevent the tap-root from passing down below the pot to any great length. The ilex, or evergreen oak, may be reared with advantage in the same manner as that now described. It is more hardy than the preceding tree. Its merits for ornament and shelter are well known; it appears to have been introduced into England from the south of France in 1581.

The kermes oak, *Quércus coccífera*, is worthy of remark here, although of so humble a habit of growth as not to attain the size which constitutes a timber tree. The scarlet, or red purple dye of the name, which supplanted the substitute obtained from a species of the *murex*, shell-fish, and used for the anciently celebrated Phœnician *purple* dye, is afforded by this oak-shrub (for the plant seldom rises above five feet, and often does not exceed two,) in the form of small red galls, caused by the puncture and subsequent deposition of the eggs of an insect, called *coccus ilicis*. This dye, in its turn, however, has been supplanted by the *cochineal cóccus cácti*, an insect itself, found on one or more species of the *cáctus*, or Indian fig, but more particularly the *Cáctus cochinillifer* or the *Opúntia cochinillífera*. The kermes oak is a native of the south of Europe, and was introduced into England about 1683.

Of the other species of oak enumerated below, the dyers' oak, *Quércus tínctoria*, demands notice, on account of its bark furnishing the yellow dye, *quercitron*, a substance much used in dyeing wool, silk, and paper-hangings It is the cellular integument of the bark that supplies the colouring matter. Doctor Barncroft states, that one part of *quercitron* is equal to ten parts of *woad*. It is stated, that to dye wool it is sufficient to boil the quercitron with an equal weight of alum; in dipping the stuff the deepest shade is given at first, and afterwards the straw-colour*. This species of oak appears to have been introduced into England as early as 1739; but its useful property now alluded to seems not to have been proved, or, in fact, tested in this climate. Its wood is considered inferior to that of the common oak.

*Timber or Forest Species.*

| OAK-TREE. | QUERCUS. | Native of | Ft. |
|---|---|---|---|
| Common..... | *róbur pedunculáta* | Britain... | 60 |
| Sitting acorned .. | *sessiliflóra*.. | —— | 40 |
| Woolly-petioled, or Durmast .. | *pubéscens* .. | England.. | — |
| Turkey-mossy-cups | *cérris* ..... | S. Europe . | 50 |
| Var. Rough-lvd do. | *bulláta*..... | —— | — |
| „ Nar.-lvd. do.. | *sinuáta* .... | —— | — |
| „ Fulham..... | *dentáta* .... | —— | |
| Evergreen..... | *ílex* ..... | —— | — |
| Var. Notch-lvd. do. | *serráta* .... | —— | — |
| „ Long-leaved . | *oblónga* .... | —— | — |
| „ Lucomb's ... | *lucombeána*. | Levant | — |
| Champion red.... | *rúbra* ..... | N. Amer... | 80 |
| Var. Mountain red | *montána* ... | —— | — |

* The Hortus Kewensis states it to have been introduced into England in 1699, by the Duchess of Beaufort.

* North American Sylva., i. p. 93.

*Species for Ornament, or whose value for Timber of British growth has not yet been ascertained.*

| OAK-TREE. | QUERCUS. | Native of | Ft. |
|---|---|---|---|
| White* | *álba* | N.Amer. | 70 |
| Willow-leved | *phéllos* | —— | 50 |
| Live | *virens* | —— | 40 to 45 |
| Ash-coloured | *cinérea* | —— | 18..20 |
| Laurel-leaved | *laurifólia* | —— | 40 |
| Var. Blunt do. | *obtúsa* | —— | |
| Tile-cupped | *imbricáta* | —— | 40 |
| Holly-leaved | *gramúntia* | —— | |
| Cork-tree | *súber* | S. Europe | |
| Kermes | *coccífera* | —— | 2 to 15 |
| Broad chestnut-lvd. | *prínus* | —— | 80 |
| Var. Long-leaved | *oblongáta* | —— | |
| Common water | *aquática* | N. Amer. | 40 |
| Var. Vari.-lvd. do. | *heterophýlla* | —— | 20 |
| „ Long-lvd. do. | *elongáta* | —— | 30 |
| „ Entire-lvd. do. | *indívisa* | —— | |
| „ Nar.-lvd. do. | *attenuáta* | —— | |
| Black | *nígra* | —— | 30 |
| Three-lobed | *trilóba* | —— | |
| Downy-leaved | *elongáta* | —— | |
| Dyers | *tinctoria* | —— | 90 |
| Scarlet | *coccínea* | —— | 80 |
| Marsh | *palústris* | —— | 90 |
| Ilex-leaved | *ilicifólia* | —— | |
| Gt. prickly-cupped or Velanida | *ægilops* | S. Europe | |
| Italian | *éculus* | —— | |
| Starred | *stellátá* | N. Amer. | 40, 50 |
| Lyre-leaved | *lyráta* | —— | 80 |
| Grey | *boreátis* | —— | 50 |
| Bear-oak | *banistéri* | —— | 3, 4 |
| Beech-like | *fagínea* | S. Europe | |
| Hisped-cupped | *haliphléos* | France | |
| Soft-jagged-leaved | *Taúzin* | S. Europe | |
| Austrian | *Austríaca* | Austria | |
| Amer.-mossy-cup | *ovalæfórmis* | N. Amer. | |
| Clustred | *conglomeráta* | Europe | |
| Cypress | *fastigiáta* | Pyrenees | |
| Repand | *repánda* | N. Amer. | |
| Cork-like | *pseúdo-súber* | Spain | |
| Over-cup-white | *macrocárpa* | N.Amer. | 60 |
| Barren-scrub | *catesbáei* | —— | 10, 20 |
| Dwarf | *nána* | —— | |
| Spiny-leaved | *agrifólia* | —— | |
| Dwarf-chestnut | *prinoides* | —— | |
| Yellow-chestnut | *castánea* | —— | 70 |
| Swamp-white | *micháuxii* | —— | 80 |
| Rock-chestnut | *montána* | —— | 40, 60 |
| Two-coloured | *bicolor* | —— | 70 |
| Turner's | *Turnerii* | —— | |
| Levant | *infectória* | Levant | |

* The white oak is in high estimation in North America. Michaux states that the value of staves made of this species of oak received by England in 1808 amounted to 146,000 dollars, and the number of staves sent to the West Indies exceeded 53,000,000. The price has varied greatly within the last hundred years: 1720, three dollars a thousand; in 1798, eighteen dollars; and in 1806, thirty dollars. In 1807, before the American embargo, they were advertised at fifty-five dollars, and in 1808, after that municipal regulation, at one hundred dollars!

| OAK-TREE. | QUERCUS. | Native of | Ft. |
|---|---|---|---|
| Subdeciduous | *castellána* | S. Europe | |
| Glossy-leaved | *lezermiána* | —— | |
| Spreading | *expánsa* | —— | |
| Calycine | *calycína* | —— | |
| Portugal | *lusitánica* | Portugal | |
| Crenated | *crenáta* | S. Europe | |
| Running | *sericea* | N.Amer. | 20in. |
| Sea | *maritima* | —— | *3,8 |

*Cupuliferæ. Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| BEECH-TREE. | FAGUS. |

*Monœcia Polyandria. Linn.*

MALE FLOWER—*calyx*, bell-shaped, five-cleft; *corolla*, none; *stamina*, five to twelve. FEMALE FLOWER—*calyx*, four-cleft; *corolla*, none; *styles*, two or three, three-cleft; *seeds*, an angular or three-corner shaped nut, one or two contained in each muricate capsule, which opens with four valves, and emits the seeds or nuts.

*Time of sowing the seeds*—from October to February: they require particular protection from field-mice and other vermin. *Soil*—Siliceous, sandy soils are well adapted for the growth of the beech; or it will attain a great size in elevated clayey loams incumbent on sand: it will prosper on chalky, stony, barren soils. *Uses*—It is used by cabinet-makers, turners, mill and wheel-wrights, for cogs, spokes, and felloes. In the dockyards it is used for wedges, &c. It is also used by musical-instrument-makers for sounding-boards, &c.; by coopers for clapboards. Near large towns it is in great demand for billet-wood. It affords a large quantity of potash and good charcoal.

In Devonshire, where the severity of the western winds is great, the beech appears to withstand the bad effects better than most other kinds of trees, and this hardy habit of it renders it valuable for planting in high chalky and gravelly soils, where shelter is of so much importance to the surrounding lands. According to Vancouver†, the beech and sycamore are found most powerful to resist the rigour of the westerly gales. The nuts, or *mast*, of the beech afford an oil ‡ by expression,

* Michaux, in his 'North American Sylva,' states, that there are found forty-four species of oak between the 20th and 48th degrees of north latitude of that continent.

† Survey of Devon, p. 251.

‡ It is considered next in fineness to the olive oil. According to Michaux, the forests of Eu and Crécy, in the department of the Oise, have yielded in a single season two millions of bushels of beech-nuts.—Ibid.

which the poorer inhabitants of Silesia are said to use as a substitute for butter. The nuts are sometimes roasted, and used for coffee. This tree is a native of the greater part of Europe, but is not found so far north as the northern provinces of Sweden. In England it prevails most in the range of chalk hills which run from Dorsetshire, through Wiltshire, Hampshire, Surrey, Sussex, and Kent, and more partially in Berkshire, Buckinghamshire, and Hertfordshire. It is not uncommon also on the Cotswold Hills in Gloucestershire, and in some parts of Monmouth. In Scotland, where its being indigenous is doubted, large plantations have been made, particularly by the Earl of Fife in Murrayshire, and by George Ross, Esq., of Cromarty. In certain cantons of Belgium, particularly near the village of St. Nicholas, between Ghent and Antwerp, very solid and elegant fences are made by planting young beeches seven or eight inches apart, and bent in opposite directions, so as to cross each other, and form a trellis. During the first season they are bound together by osiers at the points of intersection, and in time become grafted, forming apertures of four or five inches in diameter.

The bark of the American white beech is used for tanning leather, when there is a scarcity of oak bark: the leather made from it is white and durable, but inferior in this last respect to that tanned with oak bark. The purple or broad-leaved American beech is held in higher esteem in North America than the former. It is a hardier and a larger-growing tree. The timber is described as being less compact or solid than that of the English beech; planks of it, however, three inches thick, are exported to England. In summer, while the sap is in the vessels of the wood, it is considered a superior season for felling the beech to that of winter; and Michaux states that experience has demonstrated the fact, that the timber felled in the former season is greatly more durable than that which is felled in winter.

*Timber or Forest Species.*

*Cupulíferæ. Nat. Sys.*

| BEECH-TREE. | FAGUS. | | |
|---|---|---|---|
| *Monœcia Polyandria. Linn.* | | | |
| Common..... | *sylvática* ... | Britain ... | 70 |

*Species for Ornament, &c.*

| BEECH-TREE. | FAGUS. | Native of | Ft. |
|---|---|---|---|
| Var. Purple..... | *purpúrea* .. | Germany . | 30 |
| „ Golden stripe leaved..... | *fóliis aúreis* | | |
| Copper-leaved.... | *cúprea*..... | | |
| Broad-leaved..... | *ferruginea* . | N. Amer... | 40 |
| White..... | *sylvéstris*... | —— ... | 30 |
| Fern-leaved..... | *comptoniæfól.* | —— | |

*Cupulíferæ. Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| CHESTNUT. | CASTANEA. |

*Monœcia Polyandria. Linn.*

MALE FLOWER—*ament*, naked; *calyx*, naked; *corolla*, five petals; *stamina*, ten to twenty. FEMALE FLOWER—*calyx*, five or six-leaved, muricate, or covered with soft spines; *corolla*, none; *stigma*, pencil-shaped; *seeds*, nuts, three, ovate, three-sided, enclosed in a roundish capsule, covered with soft spines.

*Time of sowing the seeds*—February. *Soil*—A rich sandy loam raises the chestnut to the greatest perfection as a timber-tree; but it appears to come to great maturity in clayey soils, if free from stagnant moisture. It will thrive also in gravel or sand, if not in too bleak or exposed a situation. *Uses*—The timber of the *castanea vesca*, or sweet chestnut (see page 9, *fig. e*), is said to be equal to that of the oak. For underwood or shelter, in a favourable climate, there can be no doubt of its great value, affording a fall in every ten or twelve years for hop-poles, hoops, &c. The chestnut, if not originally a native of Britain, has at least been long naturalized in the climate. The most ancient tree of this species on record is probably that mentioned by Bradley* in Lord Ducie's park, at Totworth, Gloucestershire. He states that, in 1150, it was styled the great chestnut of Totworth; and that, in 1720, it measured fifty-one feet in circumference at six feet from the ground. The same tree is mentioned, in 1791, by Lysons, who etched two views of it. This chestnut, it is highly probable, had lived a thousand years, and hence we may conclude its long duration in the soil. At Buckland, the seat of Robert Throckmorton, Esq., M.P., are to be seen some remarkably fine specimens of this tree; in several places in Kent, and on the banks of the Tamer,

* Gentleman's Magazine for 1766, p. 321. See also Martyn's Miller's Gard. Dict.

in Cornwall, all evincing the great perfection to which it arrives on a sandy, gravelly, or clayey loam. The wood, as already mentioned, is considered to be of equal value to that of the oak, and is applied to the same purposes: opinions, however, vary on the subject, and it is probable that the conclusions drawn from the supposed facts of the wood of the chestnut being found sound in very old buildings, are liable to some degree of doubt, inasmuch as a decisive proof of such wood being chestnut and not oak does not appear to have been brought forward. We have at pages 8 to 11 pointed out a certain means of identifying the wood of different species of trees. The value of the bark of the chestnut for tanning is inferior to oak bark, and the tree is not so hardy: with these deductions, and they are considerable, the two species of trees may be considered of equal interest to the planter. The value of the chestnut for coppice wood for the produce of hop poles, is well known. The varieties of the common chestnut mentioned below are very ornamental trees. The American chestnut differs but little from the English. It is most common in the mountainous districts of the Carolinas and of Georgia, and it does not appear beyond the 44th degree of north latitude. It flourishes, Michaux states, on the sides of mountains, where the soil in general is gravelly. The nuts are smaller and sweeter than those of the European species, and are sold at three dollars per bushel in the markets of New York, Philadelphia, and Baltimore. The wood is thought to be inferior to the European species. In France that of the common chestnut is held in high esteem for coppice wood: it is cut every seven years for small hoops, &c.; at fourteen years for large hoops, and at twenty-five for posts and light timber. Land so occupied, it is stated, yields a rent superior to that under other kinds of crops in the proportion of four to one. The Chincapin chestnut is not otherwise remarkable than for the beauty of its foliage and the diminutive size of its fruit.

*Timber or Forest Species.*

| CHESTNUT. | CASTANEA. | Native of | Ft. |
|---|---|---|---|
| Sweet or Spanish | *vésca* | England | 50 |
| American | *Americána* | America | — |

*Species for Ornament, &c.*

| CHESTNUT, | CASTANEA. | Nativ of | Ft. |
|---|---|---|---|
| Var. Gold-striped | *vésca* | England? | 50 |
| „ Silver | —— | —— | — |
| „ Fern-leaved | —— | —— | — |
| „ Shining-leaved | —— | —— | — |
| „ Dwf. or Chincapin | *púmila* | N.Amer. | — |

PLATANEÆ. *Nat. Sys.*

| Eng. Name. | Bot. Name. |
|---|---|
| PLANE-TREE. | PLATANUS. |

*Monœcia Polyandria. Linn.*

MALE FLOWER—*ament*, globe-shaped; *calyx*, none; *corolla*, scarcely perceptible; *anthers*, growing around filament. FEMALE FLOWER—*calyx*, ; *ament*, globular; *corolla*, many-petalled; *stigma*, recurved; *seed*, roundish, with a foot-stalk, terminated by an awl-shaped style, with a capillary pappas at the base.

*Time of sowing the seeds*—immediately after they are ripe, in a moist, shady situation, or by layers and cuttings in March. *Soil*—This tree prefers moist loam, but free from stagnant moisture. *Uses*—Except for fuel, the timber appears to be of little value. The trees are admired for their beautiful shade. The oriental plane is hghly praised by ancient writers. Ælian and Pliny extol it for the magnitude of its growth and beauty of form. It is generally believed that this tree was introduced into England by the great Lord Chancellor Bacon, although its introduction, according to Turner's Herbal, is set down as in 1562, or one year before the birth of that illustrious man; one thing is certain, that his plantation of it at Verulam first brought this tree into public notice. Its culture of late years has fallen into disrepute from the inferior quality of its timber. The American plane, or button-wood, is also a tree of large growth. Michaux measured one on the banks of the Ohio, whose stem, at five feet from the ground, gave forty-seven feet in circumference. This tree being more tender, or liable to be injured by the late spring frosts, has been sparingly planted of late years in England, and its wood is not of more value than the former.

*Timber or Forest Species.*

| PLANE-TREE. | PLATANUS. | | |
|---|---|---|---|
| Oriental | *orientális* | Levant | 50 |
| American | *occidentális* | N.Amer. | 70 |
| Spanish | *acerifólia* | Levant | |

*Species for Ornament, &c.*

| PLANE-TREE. | PLATANUS. | Native of | Ft. |
|---|---|---|---|
| Wave-leaved | *cuneata* | Levant | 50 |

| Eng. Name. | Bot. Name. |
|---|---|
| SWEET GUM-TREE. | LIQUIDAMBER. |

MALE FLOWER—*ament*, conical, common; *calyx*, or *involucre*, four-leaved; *corolla*, none; *filaments*, numerous. FEMALE FLOWER—*calyx*, in a globe, four-leaved; *corolla*, none; *styles*, two; *capsules*, two, enclosed at the base by the calyx, one-celled; *seeds*, many.

*Time of sowing the seeds*—Spring, in pots or boxes of light earth; to be shaded during summer, and protected from severe frost in winter: may be propagated also by layers. *Soil*—It will succeed best in a sandy loam, but will thrive in most kinds of soils of an intermediate quality between moisture and dryness. *Use*—Ornamental.

*Species for Ornament, &c.*

| SWEET GUM-TREE. | LIQUIDAMBER. | | |
|---|---|---|---|
| Maple-leaved | *styraciflóra* | N. Amer. | 30 |
| Oriental | *imbérbe* | —— | — |

## CONIFERÆ.

*Subordo Taxineæ. Nat. Sys.*

| MAIDENHAIRED-TREE. | SALISBURIA. |
|---|---|

*Monœcia Polyandria. Linn.*

MALE FLOWER—*ament*, naked, filiform; *corolla*, none; *anthers*, incumbent, deltoida; FEMALE FLOWER—solitary; *calyx*, four-cleft; *seed*, a drupe with a triangular shell. Propagated by cuttings.

*Time of sowing*—Propagated by layers. *Soil*—A sandy loam. *Uses*—Habit of growth and ornamental foliage.

*Species for Ornament, &c.*

| | | | |
|---|---|---|---|
| Maidenhair-tree | *adiantifólia* | Japan | 20 |

| YEW-TREE. | TAXUS. |
|---|---|

*Diœcia Monadelphia. Linn.*

MALE FLOWER—*calyx*, none, except a four-leaved perianth like a bud; *corolla*, none; *stamina*, many; *anthers*, buckler-shaped, eight-cleft. FEMALE FLOWER—*corolla*, none; *style*, none; *seed*, ovate, oblong, projecting with its apex beyond the berry, which is seated in a globular cup.

*Time of sowing seeds*—Autumn, as soon as they are ripe. *Soil*—Sandy loam; but it will also grow in most kinds of soil, particularly such as are chalky. *Uses*—Hedges for shelter. The wood is used by turners, inlayers, and cabinet-makers. It is much valued for flood-gates for fish-ponds, axletrees, cogs of mills, &c., bowls, wheels, and pins for pullies, and by turners for spoons, cups, &c. It has been disputed whether the yew is poisonous or not: the facts, however, in confirmation of the poisonous nature of the whole plant are too numerous to admit of rational doubt, and, consequently, great caution should be employed in planting it out of the reach of the more valuable domestic animals. That the berries have been eaten in very small quantities with impunity seems to be admitted; and also that sheep and goats, according to Linnæus, are less affected by taking it into the stomach, than horses and cows. The yew is a native of Britain, as well as of other parts of Europe, of North America, and Japan. The yew tree was formerly what the oak now is, the basis of our strength, for of it the old English yeoman made his bow,* as he now makes of the oak his seventy-four gun man of war.

The number of remarkable yew trees in different parts of the country are very interesting; and how much more so would they be rendered, had we records of the periods when they were planted! but we must, from want of space, refer the reader to Evelyn, Gilpin, Barrington in Archæologia. vii., xlviii., and liii., and to Martyn's Edition of Miller's Gardener's Dictionary on this point.

*Species for Ornament, &c.*

| YEW-TREE. | TAXUS. | Native of | Ft. |
|---|---|---|---|
| Common | *baccáta* | Britain | 20 |
| Var. Striped-leaved | | | |
| Upright or Irish | *Hibérnica* | —— | |

| Eng. Name. | Bot. Name. |
|---|---|
| JUNIPER-TREE. | JUNIPERUS. |

*Subordo Cupressinæ.*

MALE FLOWER—*calyx* of the ament, a scale; *corolla*, none; *stamina*, three. FEMALE FLOWER—*calyx*, three-parted; *petals*, three; *styles*, three; *pericarp*, or covering of the seed, a fleshy berry, irregular with the three tubercles of the calyx; *seeds*, three, bonelike, convex on one side and cornered on the other, oblong-shaped.

*Soil*—Light, silicious, sandy soils. *Uses*—The common juniper-bush is esteemed for its beauty as a shrub, and

* Gilpin's Forest Scenery, vol. i. p. 92.

likewise for its berries, which are used by distillers and rectifiers of ardent spirits. The plants are useful for ornament, when planted by the margins of woods. The red cedar, *Juniperus Virginiana*, attains to the size of a timber tree in deep sandy loam soils. In that part of Woburn Abbey Park called the Evergreens, said to have been planted by Miller, the celebrated author of the Gardener's Dictionary, are to be seen some remarkably fine specimens of this tree. In North America it is found wild as far as the forty-fourth and forty-fifth degrees. Michaux observes, that it becomes less common, and diminishes in size as it retires from the sea-coast. In favourable situations, as in the middle of small islands, and on the borders of the narrow sounds that flow between them and the main, it is forty and forty-five feet in height, and twelve or fourteen inches in diameter. The wood is fragrant and fine grained, strong and durable. In America, the wood is not plentiful, and is reserved for those more important purposes for which these properties are most required.

The white cedar* grows naturally in wet grounds in the marine lands of Maryland, Virginia, and New Jersey. There it attains to seventy and eighty feet in height. The wood is lighter than that of the red cedar, and is less durable. It is of slow growth in England, and even in its native soil, for Michaux counted two hundred and seventy-seven annual growths in a stem only twenty-one inches in diameter. The wood is fabricated into pails, wash-tubs, and churns.

*Species for Ornament, &c.*

| JUNIPER-TREE. | JUNIPERUS. | Native of | Ft. |
|---|---|---|---|
| Spanish | *thurifera* | S. Europe | |
| Tall | *excelsa* | Siberia | 20 |
| Red cedar | *virginiana* | N. Amer. | 30 |
| Savin | *sabina* | S. Europe | |
| Var. Striped-leav'd | *variegata* | —— | |
| „ Tamarisk-lvd. | *tamariscifolia* | —— | |
| Daurian | *daurica* | Dauria | |
| Common | *communis* | Britain | |
| Var. Swedish | *suecica* | N. Europe. | |
| „ Brown-berried | *oxycedrus* | Spain | |
| Phœnician | *phœnicia* | S. Europe | |
| Lycian | *lycia* | —— | |

* Properly belongs to *Thuja sphæroidea of Sprengel*, but ranked here according to Willdenow, under *Cupressus thyoides*.

| JUNIPER-TREE, | JUNIPERUS. | Native of | Ft. |
|---|---|---|---|
| Scaly-branched | *squamata* | Nepal | |
| Prostrate-Juniper | *prostrata* | N. Amer. | |
| Hemispherical | *hemisphærica* | Sicily. | |
| Oblong | *oblonga* | Armenia | |
| Daurian | *daurica* | Dauria | |

| Eng. Name. | Bot. Name. |
|---|---|
| ARBOR-VITÆ. | THUJA. |

*Calyx*, five-parted; *petals*, five; *capsule*, three-celled; *seeds*, solitary, very smooth, obtuse at the base, mucronate, and curved inwards.

*Time of sowing the seeds*—Spring, or as soon as the seeds are ripe. Sow in pots filled with a mixture of peat and loam. The plants are, however, generally propagated by layers—the first sort sometimes by cuttings. *Soil*—Moist, sandy loams suit these trees best: they however attain to fine trees even in damp clayey soils, or in dry sandy soils. *Uses*—They are ornamental evergreens for the fronts of plantations. The American arbor-vitæ is the only species which comes properly under the notice of the forest-planter. The value of the wood is considerable; it is slightly odorous, very light and soft grained. In Canada, according to Michaux, it holds the first place for durability. Fences made of it last three or four times as long as those of any other species. The leaves are made into a salve with hog's lard, and used in Canada for rheumatic pains.

*Species for Ornament, &c.*

| ARBOR-VITÆ. | THUJA. | | |
|---|---|---|---|
| American | *occidentalis* | N. Amer. | 25 |
| Var. Close-branched | *densa* | —— | — |
| Chinese | *orientalis* | China | — |
| Plaited | *plicata* | Nootka Snd. | |
| Weeping | *pendula* | Tartary | |
| Lucas's | *Caroliniana* | Carolina | |

| CYPRESS-TREE. | CUPRESSUS. |
|---|---|

MALE FLOWER—*ament*, imbricated; *calyx*, of one scale; *corolla*, none; *anthers*, four, and sitting, without filaments. FEMALE FLOWER—*ament*, changing to a strobile; *calyx*, one-flowered; *corolla*, none; *stigma*, two, concave, points; *seed*, an angular nut.

*Time of sowing the seeds*—Spring, in a warm situation, or in pots, in dry light earth: to be kept in the cones until the period of sowing. *Soil*—This tree delights most in a sandy loam, but it will also thrive and grow to a considerable height in clayey soils. *Use*—Ornamental and economical, as regards the wood of the

evergreen and deciduous cypresses. The wood of the upright evergreen cypress is said to resist the attacks of worms, and all putrefaction for many years. Professor Martyn says, that the doors of St. Peter's Church at Rome were built of this wood, and which lasted eleven hundred years, or from Constantine to Pope Eugenius the Fourth's time. This tree deserves to be more attended to by the British planter than it is at present. The deciduous cypress attains to a timber size in England, although it is of slow growth. Having been hitherto planted with a view to ornament rather than to economy for timber, its merits have not been proved in England. In North America its wood is highly valued, and in Louisiana, it is said to be profitably substituted for the white oak and pine. It attains to the largest size in low, damp, or swampy soils, in the southern states, rising to one hundred and twenty feet in height, and from twenty-five to forty in circumference.

*Species for Ornament, &c.*

| CYPRESS-TREE. | CUPRESSUS. | Native of | Ft. |
|---|---|---|---|
| Upright | *sempervirens* | Candia | 20 |
| Var. Spreading | *horizontâlis.* | —— | — |
| Portugal, or Cedar of Goa | *lusitânica* | Portugal | — |
| White | *thyoïdes* | N. Amer. | |
| Com. deciduous | *distichum* | —— | |
| Var. Long-leaved | *nûtans* | —— | |
| Twisting | *torulósa* | Nepal | |

| Eng. Name. | Bot. Name. |
|---|---|
| NORFOLK ISLAND PINE, | ARAUCARIA. |

*Diœcia Monadelphia. Linn.*

MALE FLOWER—*ament*, imbricated; *calyx* a woolly scale; *corolla*, none; *anthers*, ten to twelve, in the scale connate. FEMALE FLOWER—*ament*, strobile-shaped; *calyx*, one-scale, spear-shaped, leathery; *corolla*, none; *stamina*, none; *seed*, a nut, leathery, wedge-shaped.

*Time of sowing the seeds*—In pots as soon as obtained. *Soil*—A sandy loam, in a warm sheltered situation. *Use* — Ornamental. The Norfolk island pine is a most magnificent tree in its native climate. In England it is properly a conservatory plant. How far it may be capable of being acclimated has not yet been determined. Of the Chilian species of *Araucária*, planted in the open air, there is a fine specimen in the Royal Gardens, Kew, and one at Lord Grenville's, Dropmore. Governor King states, that he measured some of the former species in Norfolk Island, which were two hundred and twenty-eight feet in height and eleven in diameter.

The wood is white, close grained, and tough, and it appears to contain no resin. The bark, however, affords a fluid partaking of the properties of that substance. *Lamb. Pin.*

*Species for Ornament, &c.*

| NORFOLK-ISLAND PINE. | ARAUCARIA. | |
|---|---|---|
| Sir Joseph Banks's | *imbricâta* | Chili |
| Brazilian | *braziliâna* | Brazil |
| Norfolk Island | *excélsa* | Norf. Isl. |

| Eng. Name. | Bot. Name. |
|---|---|
| PINE-TREE. | PINUS. |

*Monœcia Monadelphia. Linn.*

MALE FLOWER—*calyx*, four-leaved; *corolla* none; *stamina*, numerous; *anthers*, naked. FEMALE FLOWER—*calyx*, scale of the strobile two-flowered; *corolla*, none; *pistil*, none. MALE FLOWER—scales of the *ament*, buckler-shaped; *corolla*, none; *anthers*, adhering to the scales, sitting, or without filaments. FEMALE FLOWER—*calyx*, scales of the *ament*, two-flowered; *corolla*, none; *pistil*, none. *Seed**, a wing nut.

*Time of sowing the seeds*—March: the seeds should not be taken out of the cones until the time of sowing arrives. *Soil*—All the fir and pine tribe affect siliceous, sandy soils, but they will flourish on rocky, and comparatively barren soils, for which they are peculiarly adapted. The *firs*, *pines*, and *larches* constitute a perfectly natural genus, or family of trees. The most obvious or ready character of distinction between them is to be found in the natural arrangement of the leaves. The *firs* have the leaves solitary, or issuing from one scale or sheath on the bark of the branches, over which they are scattered. The *larches* have their leaves in tufts, or little bundles, which are deciduous, and the *pines* have from two to five leaves issuing from one sheath at their base, and have the habit of an evergreen. One property is common to all the species of this genus, that of affording resinous matter, either from the wood, bark, or cones. The property of reproducing a leading stem or branch when divided, common to all other trees more or less, is wanting in this family of trees; and hence they are

* Sir J. Smith, in Comp. H. B.

called non-reproductive trees (see p. 33.) The universal use of the wood (page 10, *fig.* o.) renders its properties and comparative value so well known as to relieve the reader from details here on that point. The species which experience hitherto has proved to be most deserving of the attention of the profitable British planter are—

The *silver fir*, which attains to the height of one hundred and ten feet and upwards, with a proportionate diameter, in this climate.—(See pages 80—89.) It is very apt, during its first stages of growth, to have its young shoots cut by the spring frosts; and this circumstance, we believe, is the cause of the great neglect of planting this valuable fir. It has already been remarked, that it takes the lead of the larch, Scotch pine, and spruce after the first fifteen years of growth, and therefore its slower progress at first ought not to prevent its being more extensively planted than it has hitherto been in every situation where the fir, pine, or larch are proper to be planted for profit or ornament.

The *Balm of Gilead* fir in habit and appearance approaches near to the silver fir, but it is evidently inferior in every respect, although a very handsome evergreen tree. These two species are often confounded together*. The leaves of the silver fir are arranged nearly on opposite sides of the branch, comb-like. The under sides of the leaves have two white lines running lengthways, which give them a silvery hue. The leaves of the balm of Gilead are shorter, blunter, and stand nearly upright, in double rows, on the upper side of the branches; while, in the silver fir, they are flattened and irregularly single-rowed. According to Michaux, the resin of this tree is collected in America, and sold under the name of *Balm of Gilead.*

The Norway spruce is considered to attain from one hundred and twenty-five to one hundred and fifty feet in height. With the Scotch pine it is said to constitute the greatest proportion of the vast woods of Denmark, Sweden, and Norway. The timber is held to be inferior to that of the Scotch pine. The latter is called red deal, and the former white deal. This tree attains to a large size on cold damp clays, situated on declivities*. The white, black, and red spruces are of inferior value to the Norway. In America the wood of the black spruce is sawn into boards, and exported to the West Indies and to England; Michaux states that they are sold at one-fourth cheaper than those of the white pine.

The Scotch pine, *Pinus sylvestris*, whether as regards its hardy habits, growing in severe climates and in soils ungenial to almost every other kind of tree, or to its value in the production of useful timber, must stand in the first rank of forest-trees. The great elevation in which this tree will grow was mentioned before at page 44. A large exportation of the timber takes place from Riga, Memel, and Dantzic to England. In the former places, according to Mr. Lambert, it is called red deal, and in London yellow deal. According to respectable authority, this species furnishes four fifths of the tar consumed in the dockyards of Europe†.

The pinaster, having an inferior timber, claims but little notice from the profitable planter; however, it will grow in situations exposed to the sea air, and is an ornamental tree.

* Silver Fir—*Leaves* solitary, flat, emarginate, pectinate; *scales of the cone*, very blunt, pressed close.

Balm of Gilead Fir—*Leaves* solitary, flat, emarginate, subpectinate, almost upright above, never flat, *scales of the cones*, when in flower, acuminate, reflex.

* The resin, which concretes on the bark after a wound, being boiled in water, and strained through a linen cloth, is then called Burgundy pitch. By boiling the resin until the water is evaporated, and by then adding wine vinegar, the substance known under the name of *colophonium* is formed.

† In 1807 tar and pitch were exported to England from the United States to the amount of 265,000 dollars. The process of extracting the tar is nearly as follows:—The wood is stripped of the sap, and cut into billets two or three feet long, and about three inches thick. A circular mound is prepared, slightly declining from the centre to the circumference, which forms a shallow ditch. The diameter of the pile is proportioned to the quantity of the wood; to obtain one hundred barrels of tar the diameter should be eighteen or twenty feet. In the middle a conduit is made to the ditch, in which is a reservoir to receive the resin as it flows from the ignited mass. The top of the mound is coated with clay, and made hard and smooth, and on which the wood is laid in rays. The pile, when finished, is twenty feet at the base, and, at eight feet in height, twenty-five or thirty feet in diameter, terminating in a cone four feet above. It is then strewed with pine leaves, and covered with earth. It is ignited at the top similar to the process of charcoal making. The fire should act slowly, so that a pile of the above dimensions should continue burning eight or nine days. Pitch is tar reduced by evaporation.—Mic., Amer. Sylva., vol. iii. p. 142.

The stone pine is more celebrated for its seed, which is eaten as a fruit, than for the value of its timber. In Italy and the South of France the seed is served up in the dessert; and according to Sir George Staunton it is known and relished by the Chinese. It is a handsome tree.

The hooked pine, *Pinus uncinàta*, is remarkable for the very high elevation of the site on which it will grow, mentioned at page 44. Those other pines belonging to this group, enumerated below, are all more or less interesting and deserving of notice; but as the facts relative to the comparative value of their timber are not yet sufficiently numerous to lead to satisfactory conclusions, we must necessarily omit any further mention of them here. The frankincense, Virginian, or pitch, swamp, and pond pines are all natives of North America. The most valuable of these in their native climate appears to be the swamp, or long-leaved pine, as Michaux terms it. He remarks, that its mean height is from sixty to seventy feet, with a diameter of fifteen or eighteen inches for three-fourths of its length. The timber of the swamp pine is extensively used in the Floridas, Georgia, and the Carolinas. It has not yet exhibited any merits as a forest-tree in the climate of Britain.

The Weymouth pine is of very quick growth in sheltered situations, and moderately moist sandy soils; but the timber is of a very inferior quality. It is extensively used in America, under the name of white pine; it is considered to have little strength, and affording but a feeble hold to nails. It is stated to reach the height of one hundred and fifty feet, and five in diameter.* It was cultivated in 1705, by the Duchess of Beaufort.

The Siberian stone or Cembra pine, is a highly ornamental species in England; but its merits for timber have not been satisfactorily determined. It abounds in the Tyrol, where the wood is preferred to common deal for flooring, wainscoting, and other kinds of joiner's work. It appears to have been confounded with the *Pinus pygmæa*, but the species are very distinct.

The *Pinus Lambertiàna* was introduced in 1827, by Mr. Douglas, collector to the Horticultural Society of London. In its native soil, the north-west coast of America, it appears to be a tree of gigantic growth, and of great longevity. See (*) p. 70.

We come now to consider the last group or section of the pine tribe, or those with leaves disposed in tufts or little bundles surrounding a bud. The first and most valuable of these is the common larch. Scarcely any species of forest-tree has received so much attention and favour from planters, in a given series of years, as this tree; and our space will not allow of the simple mention of the names of the numerous eminent individuals, who have put its real and assumed merits to the test of trial, much less enable us to detail the various facts and opinions brought forward on the subject. Its merits are stated to have been known so early as the time of Julius Cæsar, who calls it *lignum igni impenetrabile*.* It is a native of the South of Europe and of Siberia, inhabiting the sides of the mountains, in the local hollows of which it attains to the largest dimensions. The first mention of its culture in England is given in Parkinson's Paradisus in 1629; and Evelyn, in 1664, mentions a larch tree of good stature at Chelmsford, in Essex. It further appears to have been introduced into Scotland in 1734 by Lord Kames. But the merit of making known its valuable properties as a timber tree for the climate of Britain, appears to be due to the Duke of Athol, who planted it at Dunkeld in 1741. The rapid growth of these and of other trees of the same species planted successively by that nobleman, and the valuable properties of the timber of such as were felled, realized the high character previously bestowed upon it by foreign and British authors, who were followed by others, such as Doctor Anderson, Watson, Bishop of Landaff, Marshall, Professor Martyn, Nicol, Ponty, Sang,

* The quantity of timber of this species of pine which passed down the Sorel for Quebec, between the 1st of May, 1807, and the 30th of July following, was 132,720 cubic feet of square wood, 160,000 of common boards, 67,000 feet of planks two inches thick, 20 masts, and 4545 logs. It is brought to the market of New Orleans from a distance of 2900 miles. At Liverpool, in 1808, the cubic foot was 60 cents, and planks of two inches by twelve four cents a foot.—N. A. Sylva, vol. iii. p. 171.

* Harte's Essays, Professor Martyn in Mill. Gard. Dict.

and Monteith, all confirming and further extolling the valuable properties of the tree, which has induced a somewhat general belief, that the larch is the most valuable of forest-trees, even taking precedence of the oak. It is no wonder, therefore, that the larch has been planted, and largely, in almost every kind of soil; and as it is not exempted from the influence of that natural law to which every other species of tree is subject, namely, that which restricts to peculiar soils the perfect development of all the parts of their structure and successful progress of growth to the state of full maturity or perfection—in many instances plantations of it have failed in making a return of the expected advantages, inferior even to the Scotch pine, not to mention the oak, elm, and ash, of greater value on a similar soil. On soils of the nature alluded to, namely, wet clays, springy gravels, and wherever stagnant moisture could not escape, the larch, after attaining to eighteen or twenty-five years growth, gives evidence of premature decay, or a suspension of healthy progress of growth, and when felled exhibits unsound timber, commencing in the centre of the leading roots, and penetrating upwards into the body of the tree.—(See page 74.) The instances are numerous which have come under our own observation of the fact now stated; and we mention it, not with a view to detract from its intrinsic value, or to discourage its propagation, but as a caution against the indiscriminate planting of it in soils without exception or without due examination. On declivities, and even in hollows, where clays abound, but where there is also a drainage for the superfluous water, the larch we have found to attain to great perfection*. The pruning of larch and other non-reproductive trees was mentioned at page 66.

The comparative value of the red and black species of larch has not yet been sufficiently proved; so far, however, as the trials have proceeded, the opinion is greatly in favour of the common or white larch.

The Cedar of Lebanon, *Pinus cèdrus*, so celebrated by the ancients for the valuable properties of its wood, such as continuing sound for a thousand or two thousand years, yielding an oil famous for preserving books and writings, destroying noxious insects, &c. has not been proved in the climate of Britain to afford timber of a valuable quality; it is also more difficult to propagate and of slower growth in its first stages from seed than the firs, pines, and larches to which it is allied: its culture, therefore, appears to have been confined in this country to parks and lawns, and doubtless there is no forest-tree that, when placed singly, or in small groups, confers such an air or impression of ancient grandeur and dignity upon a mansion and its grounds as a full grown Cedar of Lebanon. It is a native of the coldest parts of Mount Libanus, where now, according to the accounts of travellers, it is found in small numbers. Rauwolf, in 1575, saw only twenty-four sound trees and two old decayed ones. Maundrell, who visited the supposed site of this most ancient forest in 1696, could reckon only sixteen large trees, but many small ones. The largest measured twelve yards six inches in *girth* and thirty-seven yards in the spread of its branches. Professor Martyn remarks that Solomon's four-score thousand hewers must have considerably thinned the forest of Libanus. The same excellent author further observes, that we have now probably more cedars in England than are left on Mount Libanus—a fact which, when conjoined with that regarding the present state of the natural forests of America, mentioned at page 87, should afford matter for deep and serious reflection to those who have it in their power to plant land, comparatively waste or unproductive, in a judicious manner, but who hesitate thus to benefit their posterity and their country, from the fallacious impression that the natural forests of America and of the north of Europe, unrenovated, as they continue to be from the neglect of planting, are inexhaustible, and will continue to supply the wants of the civil and naval architectural sciences and arts of this country.

* Where stagnant moisture of the soil prevails, a comparatively great humidity of the atmosphere accompanies it, hence it is that the bad effects of unseasonable frosts or such as happen late in spring or early in autumn are always most severe on trees in such situations, and to which the larch is very obnoxious at that season when its shoots are in a young and tender state.

*Forest or Timber Species.*

First—Those with leaves solitary, scattered round the branches.

| FIR-TREE. | PINUS. | Native of | Ft. |
|---|---|---|---|
| Silver | *pícea* | Switz. | 30—80 |
| Balm of Gilead | *balsamíca* | Virginia | 50 |
| Hemlock spruce | *canadénsis* | N.Am. | 10—30 |
| Norway „ | *ábies* | N.Europe | 100 |
| White „ | *álba* | N.Am. | 50—80 |
| Black „ | *nigra* | —— | 45—50 |
| Red „ | *rúbra* | —— | 30—50 |
| Dwarf | *clanbrassiliána* | —— | — |
| Oriental | *orientália* | Levant | — |
| Bushy | *dumósa* | Nepal | — |
| Yew-leaved | *taxifólia* | Columbia | — |
| Purple-coned | *spectábilis* | Nepal | — |
| Fischer's | *píchta* | Altay | — |
| Douglas's | *Douglásii* | N.Amer. | — |
| Double balsam | *Fraséri* | —— | — |

Second—Those with leaves in pairs, or two proceeding from the base of a sheath.

| PINE-TREE. | PINUS. | | |
|---|---|---|---|
| Scotch | *sylvéstris* | Scot. | 30—100 |
| Cluster | *pináster* | S. Europe | 60 |
| Stone | *pínea* | —— | 40 |

*Ornamental, or whose value as Timber-trees has not yet been ascertained in England.*

| | | | |
|---|---|---|---|
| Upright-coned | *púmilio* | Carniola | |
| Nodding-coned | *múghus* | —— | |
| Pungent | *púngens* | N.Am. | 40—60 |
| Hudson's Bay | *banksiána* | —— | 60 |
| Sea-side | *marítima* | S. Europe | 40 |
| Aleppo | *halepénsis* | Alep. | 20—30 |
| Jersey | *inóps* | N.Am. | 40—50 |
| American pitch-tree | *resinósa* | —— | 50 |
| Corsican | *laricio* | Corsica | — |
| Hooked | *uncináta* | Pyrenees | — |
| Pallas's | *Pallasiána* | Crimea | — |
| Yellow | *lútea* | N.Amer. | — |

| PINE-TREE. | PINUS. | Native of | Ft. |
|---|---|---|---|
| Heavy-wooded | *ponderósa* | N.W.Am. | 50 |
| Gerard's | *Gerárdi* | Nepal | — |
| Crooked | *adúnca* | —— | — |
| Roman | *Romána* | Italy | — |
| Siberian | *Sibérica* | Siberia | — |

Third—Those with leaves varying from two to three.

| | | | |
|---|---|---|---|
| Two and three-leaved | *variábilis* | N.Am. | 40—60 |

Fourth—Those with leaves in threes.

| | | | |
|---|---|---|---|
| Frankincense | *tæda* | N.Amer. | 30 |
| Virginian, or Pitch-pine * | *rigida* | —— | 80 |
| Swamp | *palústris* | N.Amer. | 60—70 |
| Pond, or fox-tail | *serotína* | —— | — |

Fifth—Those with leaves in fives.

| | | | |
|---|---|---|---|
| Weymouth | *stróbus* | N. Amer. | 100 |
| Siberian stone | *cémbra*, or *aphernoúsli* | Sib. Swit. | 50—60 |
| Lambert's | *lambertiána* | N.W. Am. | |
| Pigmy | *pygmæa* | Siberia | — |
| Bhotan | *excélsa* | Nepal | — |

Leaves numerous in little bundles from the bottom or base of a sheath.

*Timber or Forest Species.*

| PINE-TREE. | PINUS. | Native of | Ft. |
|---|---|---|---|
| Com. white larch | *lárix* | Switz. | 50—80 |
| Intermediate | *intermèdia* | Altay | |
| Dahurian | *dahurica* | Dahuria | |

*Species for Ornament, &c.*

| | | | |
|---|---|---|---|
| Black larch | *pendúla* | N.Amer. | 30 |
| Red larch | *microcárpa* | —— | 80 |
| Cedar of Lebanon | *cédrus* | Levant | — |
| Indian cedar | *deodára* | Nepal | — |

* Cultivated before 1759 by the Duke of Bedford Mill. Dict. Ed. 7. n. 10.

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In looking over the above list of forest-trees, it may seem to require a reason for not arranging the names of the trees in alphabetical order, instead of adopting the natural system of classification mentioned at the commencement of this enumeration, at page 93; particularly as such a mode, under the circumstances of a partial selection from the whole of the vegetable kingdom, must necessarily, as there stated, exhibit a broken series of connexion between the individual families or groups of trees brought forward. The index, however, will supply this apparent inconvenience, and the advantages to the young forest-planter of being early acquainted with the affinities or natural connexions of different families and species of trees with each other, will, by a little experience in the practice of planting, be fully appreciated by him, should he even confine his examination to the structure of the seed, which is given in the botanical character of each genus or family of trees. The classes and orders of the Natural and Linnean systems, under which each genus of forest-trees stand, will also point out to him where may be found the discriminating characters of distinction of the different species, as in the Species Plantarum, or in systematically arranged

Floras, where such have been published, of the plants of different countries; and in the perusal of these, should a doubt occur, the above enumeration will show whether the tree or trees in question have been introduced into British planting. The height of the trees mentioned in the list is either such as we have ascertained by actual measurement, or have been assured of by respectable authority.

The advantages resulting to individuals locally, and to the whole community, from judicious planting, have been noticed at page 2, and subsequently in the course of these pages; and what judicious planting consists in, and what are the consequent profitable results from it, have also been pointed out by an appeal to facts obtained from culture, observation, and experience; which, if examined, can hardly fail to arrest the attention of those who have given little of it to this important subject, but who, nevertheless, possess the means thus to enrich their landed possessions in their own life-time, benefit their posterity, and their country. But it is not planting judiciously at first, it has been shown, that will accomplish those important results, without the essential addition of subsequent attention to skilful culture and management of the plantations throughout the entire progress of the trees to maturity, according to the purposes for which the produce of individual trees or species of trees are most valuable, and consequently their proper period of duration in the soil; these important points have been dwelt upon, and frequently urged in the course of these pages (16, 32, 61, 64, 66, and 45, 50, 67, 68, 71); and it may be here added, that there is more absolute loss to individuals who possess plantations, but who neglect the application of judicious culture to such, than accrues from the like neglect of the healthy progress of any other agricultural crop whatever. Besides, it is an evil, that this neglect leads to an erroneous opinion of the utility, and important private and public value of judicious planting, and induces many who have it in their power to plant extensively to omit it, and leave that land barren and waste, which might otherwise be so beneficially occupied in the growth of timber, and amelioration of defective local climates. The great extent of waste-land in this kingdom has been stated at page 85.

By referring to the county surveys, and to other sources of information, it will be found that a large portion of the waste, or comparatively unproductive lands, in this kingdom, is capable of being profitably employed in the growth of timber; and, taking the proportion of one-twentieth part only of the whole, there will be upwards of three millions and a half of acres available for the purpose, or say, one million and a half of acres for trees, and two millions of acres for conversion to down-pasture, or partly tillage, by the aid of the shelter and amelioration of the local climates produced by the judicious disposition of the plantations. The facts and observations brought forward in evidence of the public necessity for the extension of forest-tree planting, as well as the advantages accruing from it to private estates, need not here be repeated; neither need it be recalled to mind, that the perpetual consumption of timber from the natural forests of this country, without any aid being afforded in return to renovate or keep up a succession of trees by planting, at last caused that scarcity of timber for civil and naval architecture which first led to the culture of timber-trees as an article of profit, and which has brought the art of arboriculture to a higher degree of perfection in Britain than in any other country. But a similar consumption without renovation is now going on in those countries from which we fallaciously expect an inexhaustible supply of timber; and we cannot but press upon the attention of those in whose power it rests, and whose duty it is to provide more largely for posterity than our ancestry has provided for us, that with the more perfect knowledge now possessed of the art of planting, the large extent of fit, but unoccupied soil, and the superabundance of unemployed labourers, to effect the work to its fullest extent,—this important object ought to be forwarded with that zeal, energy, and skill, which have been already displayedby some few individuals, and have been uniformly attended with success.

# ORNAMENTAL PLANTING.

In the preceding parts of this treatise we have confined ourselves almost entirely to planting for profit, and have merely enumerated with brief remarks those trees, which, though incapable of being cultivated with advantage in our climate for economical purposes, produce striking effects in landscape scenery, and are of great value in the adornment of parks and pleasure grounds. They are not for the most part scarce in the nurseries of Great Britain, yet as we have observed that the planting of exotic trees is comparatively neglected, a few pages may be not unprofitably occupied, in pointing out such as seem peculiarly deserving of attention.

The beauty of English park scenery is universally admitted: the constant source of fresh admiration to foreigners, and of delight to ourselves, it may, perhaps, be briefly described, as the art of imitating, in small compass, the most lovely scenes of external nature. In a pursuit so fascinating, the most elegant mind may find amusement, the most active benevolence room in which to dilate. In eliciting from crude materials new forms of beauty; in opening the valley; converting the barren hillside into wood; in expanding the lake, and clothing a once naked district with luxuriance, the worth of an estate is increased, health improved, and charity the most useful dispensed, for

> 'Hence the poor are clothed, the hungry fed,
> Health to himself, and to his children bread,
> The labourer bears.'

The general practice cannot be much improved, but some beauties of detail may be gained, by a more frequent employment of foreign vegetation. Every one is aware of the charming effect of the weeping willow: this is a case in point. The light ramifications of the Robinia contrast beautifully with the bolder form of the oak; the hiccory, or black American walnut, relieves the heavy masses of the elm; the lucid green of the Spanish chestnut is well opposed to the dinginess of the beech; and the brilliant tints of many North American trees when in decay add a new and remarkable feature to the autumnal landscape. But the interest arising from the adoption of foreign trees into domestic scenery is not confined to their picturesque effects. They remind us of the climes whence they come, of the scenes with which they were associated. In exploring a well-selected arboretum, the eternal snows of the Himalaya, the savannahs of the Missouri, the untrodden forests of Patagonia, the vallies of Lebanon, pass in review before us: we seem to wander in other climes, to converse with other nations.

Although few foreign trees become permanent with us, many bear our climate well, yet, tried by the test of spontaneous propagation seem not to be capable of perfect naturalization. No genus is of more frequent occurrence in England than the hardy lime-tree, of which at least three nearly allied species inhabit the continent. In European Russia they abound, and supply the bark from which the mats so largely used in our gardens are made. Here, though with attention the lime may be raised from seeds, nothing is rarer than to meet with a spontaneous seedling, even near individuals of great size, covered with myriads of seeds, mature, but, by some unsuitableness of climate, bereaved of competent vigour

to rear themselves unaided by art. The common *English* elm, (Ulmus campestris,) which peoples the hedge-rows of our southern counties, rarely perfects its seeds in England, and propagates itself by suckers. So near to us as Paris, it finds a congenial climate, and ripens them plentifully. The horse-chestnut, a native of the mountain-chains of Asia Minor, tried by the same test as the lime-tree, that of spontaneous propagation from seeds, appears to be one of the few instances of an exotic tree perfectly acclimatized in England. Perhaps another instance may be found in the Turkey oak, (Quercus cerris,) and some cases exist among coniferous trees. But though the laws of nature forbid us to hope for the perfect naturalization of many trees of other climates differing but little from our own, they allow us to embellish our domains with the rich variety resulting from the elegance of their forms, and the diversity of their tints. We have already alluded to the tree usually called the Turkey oak, (Q. cerris,) a native of the middle elevations of the Papal states, Tuscany, and southern Italy: it is always distinguished by the Italian writers from the common oak, (Q. robur,) as the *cerro*. About the lake of Perugia, and the scene of the memorable battle of Thrasymene, it attains to enormous bulk, and is very picturesque in its form, though its branches are not so abrupt and angular as those of our native oaks. In England it seems to be perfectly at home, grows fast, and produces abundance of acorns, bears bleak exposures, and thrives in lighter and more silicious soils than suit the oaks of England. It retains its leaves far into the winter, a valuable property when shelter is desirable. There is, perhaps, cause for apprehending that it will not thrive so well in a confined or crowded, as in an airy situation. Mr. Atkinson, the eminent architect, having converted a specimen of good size, which he found at the seat of the Marquis of Downshire in Berkshire, has proved experimentally its valuable properties for ornamental purposes in domestic architecture. Its wood is closer in its grain, bears a higher polish, is richer in colour, and more varied in its markings than the wood of our indigenous oaks, or that which is brought down the Rhine from the forests of southern Germany, and imported into this country by the name of wainscoat oak, being, in point of fact, the produce of the Q. robur, and Q. sessiliflora, and owing its peculiarities to a more rapid growth in a more genial climate. We cannot too strongly recommend this beautiful and fast growing tree to our readers, combining as it does beauty of form, rapidity of growth, and much indifference about its soil, with a constitution of singular hardihood. We have seen it thrive in exposures where our own native oak and beech became stinted. A sub-variety of the Turkey oak, or more probably a distinct species, is known in the nurseries by the name of the Fulham oak, (Q. dentata, page 111,) after the parent tree, a magnificent specimen, now growing in the nursery ground of Messrs. Whitley and Co. at Fulham: it is highly deserving of cultivation. The Luccombe oak, supposed by some to be a hybrid production between the Turkey and Cork oaks, but more probably an indigenous Spanish species, is a pyramidal tree, apparently of moderate growth, and almost an evergreen. The Cypress oak, (Quercus fastigiata, page 111,) a native of the Pyrenees, and of the mountains of Portugal, resembles the English oak in leaf; but is of habit probably unique in this genus, carrying all its branches upright like a Cypress or Lombardy poplar, a circumstance of some value in landscape planting. Q. tauza or toza, the Chêne taussin of the French, indigenous to the *landes* of Bourdeaux and sandy soils of the south of France, is of low growth, with a very indented leaf, pubescent on its under surface; it is said to trace much from its root.

The ornamental qualities of the ilex are universally appreciated; the cork-tree, whose singular beauty of form and foliage are the admiration of all travellers in southern Spain, too tender to thrive except in a few favoured spots in our southern counties, is sufficiently described in the list of forest-trees, (page 111.) But the oaks of North America claim the deepest attention from the ornamental planter. Ranging through many degrees of latitude, and growing at very different elevations, consequently under much variety of climate, some of them are hardy with us, some tender; but all abhorrent of wet or clayey soils. Deprived of the cloudless sun and high temperature of an American summer and autumn, they cannot ripen their shoots sufficiently to be frost-proof, except upon soils of a light and warm nature. Their foliage is beautiful, frequently singular: with the effect of their autumnal tints of crimson every British tree fails in comparison.' We shall only advert to such of those described by Michaux and Pursh, as we believe to be calculated to succeed in this country. In the garden of the Pêtit Trianon, at Versailles, the favourite retreat of the ill-fated Marie Antoinette, a fine specimen of the willow-leaved oak, (Q. phellos,) is very ornamental; it is not unusual in sheltered villa gardens in the neighbourhood of London, but in an inland situation in Hampshire, elevated about 600 feet above the sea, its shoots have been killed every winter. Q. humilis, maritima, sericea, cinerea, (Pursh,) are all related to Quercus phellos, and probably tender. Q. imbricaria is hardy and very deserving of notice, on account of its beautiful, shining, almost entire leaves, little resembling the familiar appearance of the oak. Q. tinctoria, discolor, coccinea, alba, rubra, montana, olivæformis, all hardy upon light soils, all attaining to large size, all beautiful in their perfect foliage, are superb during its decay. Q. tinctoria, one of the largest and finest trees of the North American forests, produces the valuable material so well known in commerce as quercitron bark. An oak of great size and promise, with fine broad leaves, and immense acorns, (Q. macrocarpa,) was introduced by the late Mr. Lyon, from the state of Tenessee. We have seen it only in the high situation in Hampshire before mentioned, where it has been unable to ripen its shoots. Most of the oaks enumerated by Michaux, as varieties of Q. prinos, but by Pursh as distinct species, must be tender in England, except under very favourable circumstances; perhaps by grafting them upon the Turkey oak, thus furnishing them with roots of hardier constitution than their own, their shoots may be ripened with greater certainty. The oaks of Spain, upper Italy, Croatia, Bosnia, and Turkey, are very imperfectly known; some of them are allied to Q. cerris, but are sufficiently distinct to make it desirable that we should possess them. Mr. Walsh, in the Transactions of the Horticultural Society of London, vol. vi., describes an oak growing near Constantinople, (Q. pubescens,) as a fine and beautiful tree; its leaves covered with down beneath, and its branches when young, pendulous, like those of weeping willows. It is probable that interesting species exist in the unexplored and classical regions of Asia Minor, now by the advancing civilization of the Ottomans, and the improvement in their government, laid open to the researches of travellers. But by far the most curious additions to our oaks, perhaps to the arboretum generally, are to be derived from the mountains of the Himalaya. We earnestly invite the attention of individuals connected with India, to the vegetable treasures of this region; whose valleys, more elevated above the sea than the top of Mont Blanc, contain within their bosoms most interesting species of oak, birch, walnut, fir, cedar, and other genera of cold climates, calculated by their beauty to adorn our parks and gardens in the highest degree. Some

of these have been made known to us by the active researches of English botanists. Q. grandifolia, with immense shining leaves, equalling those of Magnolia grandifolia in size and texture, has been figured in Mr. Lambert's splendid work on the genus Pinus. Q. spicata, with entire leaves from six inches to a foot long, and acorns numerously crowded upon an upright spike from ten to eighteen inches in length; Q. lamellosa, with firm leathery leaves, smooth and glossy above, mealy and nearly white beneath, sometimes a foot in length, and as much as five inches in breadth, are both figured in Dr. Wallich's magnificent work, the Plantæ rariores Asiaticæ, now in course of publication, and we hope of encouragement, commensurate to its extraordinary claims upon every lover of natural history.

The coarse foliage of the elm, in our opinion, degrades it from the first class of ornamental trees, but in some situations, particularly in deep and somewhat damp soils, it succeeds better than many, and grows to vast size. Its varieties are curious—the variegated leaved elm is not without merit—the weeping elm is sometimes picturesque—the small leaved Cornish elm is perhaps the most elegant. The American elms seem to be deserving of attention. Mr. Hodgson, a recent traveller in the United States, was much impressed with the stupendous stature of specimens of the ulmus Americana around the neat villages of New England.

The giant bulk and extraordinary beauty of the oriental plane tree (Platanus orientalis) have made it, in all ages, the object of marked attention. Every classical reader is aware of the favour with which it was regarded by the Greeks and Romans, the latter of whom, according to the Latin writers, carried their admiration of this beautiful tree so far as to occasionally irrigate it with wine. Hardly less beloved by the Turks in modern days, it is with them a usual practice to plant one at the birth of a son. In the court of the Seraglio, as we are told by Mr. Walsh, is a venerable specimen, planted by Mahomet the Second, after the conquest of Constantinople, in commemoration of the birth of his son Bajazet the Second; it is now fifty feet in girth, the increment of three hundred and seventy years. At Buyukdéré, on the Bosphorus, is another of almost unequalled size: it stands in a valley, and is forty-five yards in circumference, but, in fact, now consists of fourteen large trees, growing from the same root-stock, coalescing near the ground, but, at some distance from it, diverging into distinct trunks. The oriental plane is indigenous throughout Asia Minor, ranging to a considerable elevation, but attaining its greatest size upon low levels and in deep soils. The specimens, whose remarkable bulk has conferred upon them an almost historical notoriety, are all situated not much above the level of the sea. In England this tree is perfectly hardy, and of the first beauty. It is remarkable, that though introduced here three hundred years ago, under the auspices of Lord Chancellor Bacon, it has been comparatively neglected since the introduction of the North American plane (Platanus occidentalis), which, being propagated with much greater facility from cuttings, has long been in almost undivided possession of the nurseries. Much inferior to the Oriental in beauty of leaf, though, according to American writers, not in size or majesty, the occidental plane, which attains its utmost luxuriance in the warm valleys of the Ohio, and upon the limestone soils of Kentucky and Tenessee, has proved incompetent to contend with our spring frosts, our sunless summers, and our clouded autumns. About twenty years ago, a great proportion of all the individuals in England, without respect of age or bulk, were killed outright by a late spring frost. Since then we have seen them repeatedly injured, and, when half recovered by the

operation of a summer of more than average warmth, again replunged into the same state of debility, whilst the oriental plane has remained quite uninjured. The intermediate species (P. cuneata, P. acerifolia) seem to be hardier than the American plane, but less so than the oriental plane.

Another American tree, of large stature, high beauty, and hardihood, is the tulip tree (Liriodendron tulipifera), which, as its name imports, unites the charm of abundant pale yellow flowers, bearing some resemblance to tulips, with beautiful broad leaves, of very ornamental form and colour. When placed near the American oaks, its foliage contrasts with them finely, particularly when, in autumn, it opposes its yellow tint to their shades of crimson. It is perfectly hardy, and becomes a large tree in England when planted in dry and deep soil.

Though our principal object is to treat of exotics, yet we cannot avoid mentioning the lime-tree, one of our most stately forest trees. Naturalists decide that three species are natives of England; but that which has the fairest pretensions to be so considered, according to the authority of Sir James Smith, Tilia parvifolia, is far less common in parks, than its congeners, though, in our opinion, it excels them in beauty. The North American species are very soft-wooded trees, and, in this country, of small stature: we have observed a very extensive gangrene, sometimes extending several inches down the trunk, to follow frequently upon the amputation of one of their branches, even of moderate size. They deserve little attention, except perhaps Tilia heterophylla, introduced about twenty years ago by Lyon, the industrious collector. Tilia alba, said by some to be a native of Hungary, a round-headed, thickly branching tree, of rapid growth, and somewhat formal outline, with broad leaves, green on their upper, and white on their lower surface, an attribute well displayed when they are agitated by wind, possesses the merit of being almost the latest deciduous tree to drop its leaves at the approach of winter.

We briefly advert to the Spanish chestnut, so superb in its stature, in one memorable instance, in this country, reaching to a girth of above fifty feet*; so beautiful in its foliage, so stately in its maturity, so venerable in its age, so rapid in its progress on warm gravels or deep fertile sands, together with its elegant variety the fern-leaved chestnut of the nurseries, and pass on to that delightful exotic, whose tumid bud is the well-known harbinger of spring, whose magnificence is perhaps undervalued, because it meets us in every walk, the horse-chestnut, the Æsculus hippocastanum of botanists. A species nearly related to it, if indeed it be not a mere variety, Æsculus rubicunda, with fine red flowers produced apparently in great abundance, should be universally planted. It has been lately introduced, along with Æsculus rosea, of nearly equal beauty, from the continent, where greater attention appears to have been paid to trees than in this country. Æsculus flava and neglecta, with flowers of but moderate beauty, are elegant in foliage and habit; the flowers of Æsculus Pavia are high coloured, though small; several other hardy species are rather shrubs than trees. But all of them deserve distinguished places in the arboretum or garden, and should, if possible, be raised from the nut. Generally they are propagated by budding upon the common horse-chestnut—an operation of great facility; but, in such case, the stock is apt to swell in a ratio much greater than the graft, becoming, not only unsightly, but rendering the specimen short-lived.

The whole genus Betula is ornamental, yet perhaps the most beautiful species it contains is our common birch (Betula alba), and its variety or kindred species, the weeping birch. These trees are of much too rare occurrence in park scenery; they are picturesque in outline, light

* Vide page 117.

in foliage, silvery in bark, very effective when disposed in groups, and contrasting finely with the heavier forms of our native larger trees, but, like almost all trees of small growth, too apt to be neglected. The American species exceed them in size, but are inferior to them in elegance. They are nevertheless most interesting trees, and should be in every collection. With their tough bark, which is readily detached in large sections, the North American Indians roof their houses, and manufacture a variety of domestic utensils. Of it are formed those light canoes which float the Canadian over the vast lakes, or down the rapid rivers of his native regions, at one moment bearing along the trader, his valuable cargo, and adventurous companions; at the next moment carried upon their shoulders across the intervenient portage. It is not too much to say, that, without the assistance of this invaluable material, the fur trade would have been confined within narrow limits instead of pervading half a continent; and the progress of geographical discovery, the long labours of a Hearne, a Mackenzie, and a Franklin, would have been incomplete for another century.

A near relation to the birch is the neglected alder, neglected because common, and rarely seen, except in the shape of coppice-wood, yet reaching, in favourable situations, to a size not generally suspected. At Gordon Castle, in Bamffshire, some exist of extraordinary stature, when seen at a distance, having much the appearance of oaks. Three of them, which are described by Joseph Sabine, Esq., in the Seventh Volume of the Transactions of the Horticultural Society of London, measured, one, seventy-one feet high and nine feet four inches in girth; one, sixty-one feet and a half high and seven feet four inches in girth; and another, fifty-eight feet high and eight feet in girth, the girth being taken at five and six feet from the ground. To those who wish for trees capable of enduring abundant moisture, we recommend the cut-leaved alder (Alnus glutinosa, var. laciniata) a derivative apparently of equal size, and of growth as rapid as its type, which it greatly excels in elegance; several other curious varieties of the common alder are to be found in the nurseries. Alnus quercifolia is probably of smaller growth, and the habit of Alnus oxyacanthifolia appears to be feeble; but Alnus cordifolia of southern Italy is a fine ornamental and hardy tree. There are some other species, rather shrubs than trees, which may be used advantageously in moist localities, where a low growth of definite height is desirable.

We attribute the comparative disuse of the common ash in park scenery, and its rare occurrence as an insulated specimen, to the extreme avidity with which it is attacked and barked by deer, those enemies of the planter. Yet it is a tree of singular elegance, both in itself, and contrasted with trees of heavier foliage: it grows to immense size, attains to great longevity, and when old is strikingly picturesque in outline, in bark, and in the almost horizontal disposition of its main branches. The entire-leaved ash (Fraxinus simplicifolia) is an interesting variety; the weeping ash (F. excelsa, var. pendula) is well known, yet hardly enough appreciated. When large, it is remarkably beautiful, but it must be planted in an inclosed spot, free from the approach of cattle and sheep, who, by browsing upon its pendulous branches, would destroy the whole beauty of the specimen, and irretrievably check its growth. Fraxinus ornus, the flowering ash, is a beautiful small tree, especially in early spring, when in flower. Fraxinus lentiscifolia is a charming small tree; most of the American ash are fine in foliage, and deserve a trial in the arboretum. Many of them exist in the Jardin des Plantes at Paris, where they cannot fail to attract the attention of any person interested in forest trees.

The common walnut—disfigured in England by spring frosts, coming late into leaf, and losing the whole beauty of its foliage prematurely in autumn —cannot be termed picturesque here, whatever it may be in the warm valleys of Switzerland and Upper Italy; but we hardly know a more picturesque tree than the black American walnut (Juglans nigra), which, in North America, is one of the most stupendous inhabitants of the forest. It is quite hardy, and of moderately quick growth, but certainly possesses the fault with which we have just reproached the common walnut, of tardy leafage in the spring. Its pinnated foliage is much more dense and tufted and of a livelier colour than that of the common ash. With the remaining American species we are not acquainted, but it would appear, from the statements of travellers, that none of them are trees of great beauty.

Several species of MAPLE claim the attention of the ornamental planter; a few are large trees; the greater portion are of small growth, and upon that account are, in our opinion, of great value in the creation of park scenery, where the object being to produce much effect in moderate space, it is frequently desirable to impart artificial height to small elevations, by crowning them with high trees, and, at the same time, to occupy the low grounds and middle distances with trees of humbler stature. It is in this point of view that the genus Maple, of which we are treating, is of importance. The common maple (Acer campestre) is rarely planted, and comparatively unknown as an ornamental tree, though few objects are more beautiful than it is when old, and arrayed in its bright yellow autumnal livery. The Norway maple (A. platanoides) excels the common maple but little in height, and is rather remarkable for its sturdy formal character. In early spring, just before the appearance of its leaves, it is covered with a multitude of yellow flowers; in autumn, when in incipient decline, few trees can contend with it in beauty; its leaves assume decided but various colours, singularly effective, owing to the distinct masses in which they are apt to arrange themselves. Whilst the greater part of the tree remains green but little faded, a whole branch suddenly becomes dull red, then another mass bright yellow, a tint which, gradually creeping over the whole foliage, is the forerunner of its fall. The ash-leaved maple (A. negundo), somewhat loftier than the Norway maple, and not possessing its formality, requires especial notice. Hardy, free growing, and graceful, when placed, as we are in the habit of seeing it, near trees of sombre hue, the very vivid green of its light foliage stands out distinct and brilliant, offering one of the best examples of the great beauty to be attained, by bringing into contrast trees of different tints. Several of the American maples are beautiful small trees; the sugar maple is of large growth, and curious from its valuable economical properties; but the most interesting species of this genus is A. macrophyllum, a huge tree, with broad leaves and most valuable dense timber, which has been lately introduced from the banks of the Columbia in North Western America, a region of stupendous vegetation, by Mr. David Douglas, the enterprising collector of the Horticultural Society of London. A. circinatum of the same country, also introduced by him, is a very handsome small tree, with deeply incised leaves, the graceful habit of which very much attracted his attention during his investigation of these countries.

The merits and demerits of the common BEECH, its peculiar adaptation to calcareous and dry gravelly soils, and the great bulk it attains upon them, its somewhat formal and little varied outline, its heavy autumnal tint, are too well known to detain us here; but we must not pass, without notice,

its curious but puny variety, the fern-leaved beech (Fagus Comptoniæfolia), nor its very remarkable variety the purple beech, whose leaves in early spring of blood red hue, in summer uniform dull purple, are too singular, (having, we believe, no parallel among hardy trees, except a remarkable variety of hazel,) not to ensure it a place in every collection. Situations may be found in the neighbourhood of ruins, or the recess of a secluded grove, where it may be employed with happy effect. We have found the North American beech not to succeed in our climate in dry calcareous soils; and they are described by Pursh as growing upon rich deep levels. Some most interesting species exist in Patagonia and in those regions, which every effort should be exerted to procure. Perhaps the greatest desiderata in British parks are evergreen trees, not being of spiral forms. The cedar of Lebanon, the evergreen oak, and the yew, begin and end our list of such. But Captain King, in his recent arduous survey of Terra Magellanica, that region of storm, of snow, and glacier, found, we believe, three species of beech in those countries; two of them he mentions by name, Fagus antarctica and Fagus betuloides. The latter, an evergreen tree of frequent occurrence, was met with in peculiar abundance in the neighbourhood of Cape Famine: trees of three feet in diameter were plentiful, of four feet there were many, and one was measured by Captain King, which maintained a girth of seven feet, as high as seventeen feet from the root, and then diverged into three immense limbs, each of them being three feet through. Live specimens of those trees were brought to England by Captain King, but have unfortunately, we hear, been lost. Every effort should be made to re-introduce objects of such interest. The true Winter's bark, (Wintera aromatica,) a native of the same inclement countries, is also an evergreen tree of small stature, but on every account interesting. It is most probable, that many important acquisitions to our shrubberies are to be found in the same regions. Fuchsias of great beauty were discovered growing to be considerable shrubs in the vicinity of perennial snows; barberries producing excellent fruit for tarts; veronicas of great size. We mention these facts, in the hope of directing attention of amateurs to these countries generally, including the southern parts of Chili, and the archipelago of Chiloe.

Pursuing our immediate subject, we must not omit to mention a very beautiful tree resembling the sumach in leaf, Ailanthus glandulosa, a native of China, which, to singular beauty of foliage, unites great hardihood. It has the defect of coming into leaf perhaps the latest of any hardy tree; but compensates in some measure for this fault by its extraordinary gracefulness. It is easily propagated by cuttings of the roots.

The Robinia pseudacacia, or locust tree, is universally known and appreciated as being singularly well adapted to garden scenery. Rapid in its growth when young, it seems to lessen its pace materially, after twenty or thirty years, apparently in consequence of its roots penetrating into a colder subsoil, and it appears to be short lived on chalk soils. We do not think it likely to become a large tree in England, except in a few very favoured spots. Its timber possesses great durability. The various species of sweet locust, or Gleditschia, are slender trees of elegant pinnated foliage, and derive some interest from the very remarkable thorns investing some of them: they are rather garden than park trees, and require deep soil, together with a warm substratum. The same remarks as to soil apply to the genus Celtis, or nettle tree. In England we have rarely met with a good specimen; in France we have seen them of great elegance.

The willow tribe affords us one exotic of pre-eminent beauty, the Salix

Babylonica, or weeping willow. It adorned the banks of the Euphrates in the days of prophecy, and has been rendered memorable by its connexion with the captivity of the house of Israel. As might have been expected from its Assyrian origin, it is somewhat tender, and in high situations is liable to be injured by spring frosts. Nothing can exceed its beauty when properly applied. Hanging over a rock, jutting from a promontory, or reclining over an urn, few objects in nature more delight the eye of taste. The common white willow, (Salix alba,) is a tree also of great beauty, but strangely overlooked, being generally degraded most unworthily to the condition of a pollard. It grows, when indulged with its favourite situation, a deep rich soil by the side of water, to a very large size; and so placed, we have seen it attract great notice by the fine contrast between its slender silvery leaves, and the dark foliage, and dense masses of the oaks and beeches which crowned the adjoining heights. Such an example is to be found on the banks of the lake at the Grange in Hampshire, the magnificent seat of A. Baring, Esq.

No other species of willow is of equal importance in ornamental planting; but the POPLAR tribe must not be overlooked. Amongst its species, the most important, as an ornamental tree, is also the one which, because it is of the most common, hacknied occurrence, has hardly escaped the reproach of vulgarity. Yet how beautiful is the spiral Lombardy poplar when judiciously used, and when, being planted in rich deep soil, and forced into something like the bulk which it reaches in its native climate, it is tastefully contrasted with large trees of rounded forms, and its clear fine green at the same time brought into opposition with their heavier tints! Next in point of ornament is the English black poplar. The aspen derives some interest from its tremulous leaves, agitated by the slightest breath of wind; the Canadian poplar from its habit intermediate between the pyramidal Lombardy poplar, and the spreading black poplar; and the Ontario poplar, lately introduced, from its very ample leaves and singular rapidity of growth. The other species are rather subjects for a general collection, and cannot be described as decidedly trees of ornament; but the very rapid growth of the black Italian poplar, which is not a native of Italy, nor a variety of Populus nigra, but an indigenous North American species, fits it, in a peculiar manner, for many purposes of ornamental planting. The hornbeam can scarcely be deemed an ornamental tree, yet, where individuals of small growth are requisite, it may be advantageously employed. Its varieties are curious in foliage, and are more graceful than their type.

The few deciduous trees which remain for us to mention are rather garden than park trees, and require every advantage of soil, shelter, and protection: among these the genus Magnolia stands pre-eminent. Three species only can be considered as trees in this climate, and one of them, (M. grandiflora,) the loveliest tree perhaps of temperate climates, whether for its lucid foliage, or its superb and fragrant flowers, though growing in its native climes to the stature of eighty feet, with us is a small tree, under twenty feet in height, not reaching even this elevation except in sheltered spots, and within the protection and reflected heat of walls. M. acuminata, a deciduous tree, not gifted, as most of its race, with showy or fragrant flowers, possesses a splendid leaf, is much hardier than M. grandiflora, and grows in England to be a larger and loftier tree. M. auriculata, strictly a garden tree, is slender in form, spiral in habit, and elegant in foliage, every branch being terminated, in a healthy specimen, with a handsome and fragrant flower. The other hardy species, except perhaps Magnolia conspicua, are rather large shrubs than trees, though, under favourable circumstances, some of them reach to considerable

height. The Himalaya contains within its recesses a noble and lofty tree of this genus, M. excelsa, magnificent in its foliage and bulk, and covered, when in bloom, with innumerable splendid flowers. Liquidamber styraciflua is a small, but interesting garden tree. Koelreuteria pinnata, a native of China, comes under a similar class; but is entitled to much consideration on account of its very elegant pinnated leaves, and feathery flowers profusely produced in warm autumns, and occasionally succeeded by ripe seeds, from which we have propagated it. The very exotic foliage of Salisburia adiantifolia, the maidenhair tree, ought to ensure to it a place on every lawn; higher claims to distinction are possessed, in our opinion, by Virgilia lutea, a small tree of peculiar beauty of form and foliage, introduced about twenty years ago, from the mountains of Tenessee, by Mr. Lyon, and still uncommon in the nurseries. It has not yet produced its elegant papilionaceous flowers in this country, though we have heard that they have been seen at Paris. We must not omit to mention an indigenous tree, which, delighting in chalky soils, should never be overlooked by any person residing upon them, the white beam, (Pyrus aria.) The whiteness of the under surface of its leaves and the wildness of its habit are valuable properties, but indifferently shared by its near relation, Pyrus intermedia. The value of the common hawthorn in park scenery, and the remarkable union which it exhibits of beauty of flower with picturesque rudeness of form, need not be dwelt upon. Its beautiful pink variety has been long known; another pink variety, of colour more intense, and scarcely to be surpassed in the loveliness of its tint, has lately made its appearance in the nurseries, under the denomination of the new scarlet Thorn. The merit of the double-flowering variety is great, uniting to luxuriance of the individual flower, equal luxuriance in their produce. Several other curious varieties of hawthorn have been collected by the Horticultural Society of London, at Fulham. Cratægus grandiflora is a valuable small tree; and many species of Pyrus, Mespilus, and Cratægus, should find room in an extensive arboretum.

We have nearly concluded our remarks upon ornamental deciduous trees: before we proceed to the Coniferæ, so important in themselves, and so interesting from the additions lately made, and still making, to their number, we shall briefly advert to the mode of transplanting large trees, so well described by Sir Henry Stewart of Allanton in his Planter's Guide, and adverted to in page 45 of this treatise. By careful observance of the precautions laid down by Sir Henry Stewart, trees of very large size may be safely transferred to new spots; but the practice is not new: it has been more or less followed in all ages. The Duc de St. Simon describes what Louis XIV. accomplished in this way at Versailles and Marly. Thirty-three years ago large and successful operations of the same nature were performed by the late Earl of Carnarvon, at his beautiful park at Highclere in Hampshire, principally upon limes, beech, and horse-chestnuts.

We have ourselves removed large trees without failure, and have seen reason to conclude, that notwithstanding the careful preparation of the tree, the preservation of its roots and rootlets, and the careful adaptation of the soil, the success of the effort, and the immediate growth of the tree, will still depend much upon its removal at the beginning of winter, and upon copious watering early in March, to be continued at least every fortnight during the first summer after transplantation, and into the second summer if the leaves shall appear to flag in warm weather.

We observed that the principal want experienced by the ornamental

planter in this climate, is the scarcity of EVERGREEN trees, not being coniferous.

The evergreen or holm oak, is, in point of fact, our only park tree of this description; though of garden shrubs there is no want. The deficiency is partially supplied by the very interesting tribe of coniferous trees. But their forms being generally spiral, they cannot contend, either singly with the bold and varying outline, the extended, tortuous limbs, the swelling masses of tufted foliage, which give to a stately deciduous tree a character of impressive grandeur; or when aggregated over a large surface, in which case, their general monotony of tint, the tameness of their lights and shadows, and the pyramidal termination of the majority of the individuals composing the mass, deprive it of much of the beauty so universally felt in woodland scenery composed of deciduous trees.

One illustrious exception to the first clause of our proposition will at once occur to many of our readers, in the CEDAR OF LEBANON (Pinus Cedrus, p. 127.) In our enumeration, we have said that no tree confers such an air of grandeur and dignity upon the grounds surrounding a mansion, as a full grown cedar of Lebanon, not only the most beautiful of the whole tribe of hardy coniferous trees hitherto known to us, but perhaps altogether the most majestic tree which can be cultivated with perfect success in Great Britain, peculiarly suited to the character of park or garden scenery, and harmonizing better than any other with architectural objects. Thinly scattered in the more elevated vallies of Lebanon, of Taurus, and of other lofty mountain chains and groups in Asia Minor, its somewhat rare occurrence is to be accounted for, probably, by a peculiarity of constitution, which renders a free circulation of air around it quite essential to its vigour. When planted in a wood, or even on a lawn, closely surrounded by other trees, it becomes thin of leaves, feeble in habit, and incapable of swelling to large size. To its full strength and beauty, it is indispensable that no check should be opposed to the horizontal spread of its branches. Even the operation of shortening its lateral shoots, for the purpose of forcing up a leader, cannot be often repeated without injuring its health. These peculiarities render it a scarce tree in a state of nature, where it is only found in elevated, but sheltered vallies, whose vegetation is subdued by the browzing of cattle. It will never abound but in the seats of civilization, and it is exceedingly probable that the parks of England can show more cedars than the whole of the wide range of its native regions. This most interesting and majestic tree is sometimes neglected, in consequence of a groundless apprehension of the slowness of its growth,—an apprehension which we shall proceed, from authentic documents, to dispel. Highclere park, in North Hampshire, the creation of the late and present Earls of Carnarvon, claims a high rank among the most beautiful domains in our southern counties. Some fine cedars of Lebanon adorn the immediate vicinity of the mansion. Their history is interesting. The lawn on which they stand, elevated about 600 feet above the level of the sea, is at the foot of the bold northern escarpment of the Chalk Downs, which rising about 400 feet above the house, extend for twenty miles to the southward. The soil is thin and sterile; the immediate subsoil hard plastic clay, with flints; its substratum chalk, not three feet from the surface. The climate is cold, foggy, windy; the spring very backward, the summer temperature low. We shall proceed to give a tabular view of the progress of the six largest trees, from authentic memoranda, to which we have been allowed access. The two oldest specimens, No. 1 and 2 in the table, were raised from a cone gathered upon Mount Lebanon by Dr. Pococke, the celebrated oriental traveller. The seeds were sown in 1739. Two

only came up, and being planted out, remained stinted plants. They were transplanted to their present sites in 1767, being at that time about 17 inches in girth, at one foot from the ground. The other four trees were raised from a cone brought from Wilton House, the well-known seat of the Earl of Pembroke, in 1772, and were planted out where they now stand in 1778. A very healthy beech, transplanted in 1777, to a spot near these cedars, is of very inferior girth. The following table will afford a view of their progress and present condition.

| | 1787. | 1799. | 1812. | 1827. | 1832. | |
|---|---|---|---|---|---|---|
| | ft. in. | ft. in. | ft. in. | ft. in. | ft. in. | |
| No. 1. Cone from Lebanon, raised 1739, measured in 1777, 1. | 10½ 2 11½ | 4 11¼ | 6 10½ | 8 11 | 9 3½ | 3 feet from ground. |
| No. 2. Cone from Lebanon . . | 1 10⅛ | 3 11 | 6 0½ | 7 10 | 8 6 | Ditto. |
| No. 3. Cone from Wilton, planted out in 1778, next to No. 2 . . . | . . . | 3 7 | 6 7½ | 9 4 | 10 0 | Ditto. |
| No. 4. Cone from Wilton, opposite north-east angle of house, planted 1778 . . . . . | . . . | 3 7½ | 6 6 | 9 6 | 10 2½ | Ditto. |
| No. 5. Cone from Wilton, opposite south-east angle of house, planted 1778 . . . . . | . . . | . . | 6 6½ | 9 5 | 10 3 | Ditto. |
| No. 6. Cone from Wilton, in the park, planted 1778 . . . . . | . . . | . . | . . | 9 6 | 10 6 | Ditto. |

A second species of cedar (Pinus Deodara) exists in the Himalayan mountains. It attains to a great size, and in all ages has been regarded with great consideration by the natives of these countries: usually planted by them around the temples of their gods, it would indeed seem, from its name, (devadara or deodara, which means God's tree,) to be, in some measure, dedicated to that especial purpose. It bears some resemblance to the cedar of Lebanon, equals it in size, but, judging from some views of scenery in the Himalaya which we have seen, is, probably, of more aspiring habit. Seedlings have been raised in this country, and its hardihood has been ascertained by a specimen, several feet in height, which thrives in the open ground at Hopetoun House. As it can only be propagated from seed, we recommend this fine tree to the peculiar attention of individuals connected with the country of its growth.

Next in beauty to the cedar, as a park tree, we may, perhaps, reckon the Scotch fir (Pinus sylvestris.) Nothing can well be uglier than a drawn-up grove of Scotch firs. A large, undulating, and sloping wood, consisting of this tree is, on the contrary, an object of striking beauty,—beauty indeed of a peculiar and sombre character, suiting well with heathy forest land of varied surface, and finely adapted to invest with an effect novel, and impressive in this climate, a lake entirely surrounded by such a wood. Some such effect of scenery may be seen around Virginia Water, in Windsor park. The Scotch fir is also fine as a single specimen, when it becomes broad and umbrageous, and tufted; or condensed into small groups composed of a few specimens only. But, upon the whole, we are of opinion that the most appropriate application of coniferous trees, in our climate, is not to intermix them with deciduous trees, but to assemble them into what has been appropriately called a Pinetum. This has been admirably done by Lord Grenville, at his beautiful seat, Dropmore. Such an evergreen quarter is an invaluable winter refuge. The individuals composing it are derived from many countries throughout the northern hemisphere;

they possess a geographical interest; they are of great and diversified value, for sundry economical purposes; they differ much in habit, hue, and general appearance. When all other trees are despoiled of their leaves, these, unscathed by the vicissitudes of the seasons, remain unchanged. In deciding upon the site of a Pinetum, attention should be given to the nature of the soil; for though pines, in their native places, grow sometimes in very poor soils,—from the crevice of the naked rock, on the barrenest hill side, or in the most sterile sands; here, where the natives of very different climates are assembled together by human enterprise and ingenuity, to contend with conditions differing much from those to which nature had originally submitted them, every compensation that is possible should be made. Shelter is indispensable,—many of the species are delicate,—variety of surface is desirable,—some prefer a less sunny situation than others; depth of soil is essential,—the last degree of vigour should be aimed at; a deep sandy loam is to be preferred, for almost all the species should be carefully guarded from stagnant moisture, and on a cold subsoil few will thrive. To describe in detail every coniferous tree, would be but to repeat what has been already done in this work. We shall pass them in review rapidly, glancing at those which are either new, neglected, or desirable to be added to our vegetable wealth.

Among the species most generally known, the silver fir and the Norway spruce fir are conspicuous. They are both of considerable beauty, pyramidal in form, of great size and bulk, and are sometimes very stately, when standing singly. The silver fir, in England much the largest tree, grows slower than the Norway spruce, during the first twenty years of its age, but then, continuing its growth with accelerated pace, passes it by rapidly. The balm of Gilead fir (Pinus balsamea), nearly allied to the silver fir, perhaps handsomer in foliage, is not worth planting. During the first years of its existence in England, it grows with sufficient quickness, but soon relaxes, becomes diseased, and dies. We are inclined to attribute its premature fate to the average summer temperature in our climate being insufficient to ripen its rootlets sufficiently; for the tree seems to die so soon as, in the natural progress of its growth, its roots have penetrated some depth beneath the surface. The white spruce of North America (Pinus alba) is sufficiently distinguished to merit a place in the pleasure-ground; it differs from the Norway spruce by the peculiar blue hue of its foliage. Pinus nigra and rubra, spruce firs of much humbler growth, are rather subjects for the Pinetum than for the park generally. A most magnificent tree, resembling a silver fir upon a large scale, (Pinus spectabilis,) has lately been introduced from the mountains of the Himalaya. Nothing in the fir tribe can easily surpass in beauty this fine tree, whose silvery bark, bright green leaves, white beneath, and purple cones, studded with drops of transparent resin, render it an object of high attraction. It grows to large size, and, in the south of England at least, is hardy, though, owing to the earliness of its spring growth, it will be liable to receive injury from frost. It is still exceedingly scarce in the nurseries, where it has been increased by cuttings, a mode of propagation ill adapted to produce a fine tree. Every exertion should be made to procure its cones; no matter of difficulty now that the British dominion has extended over the remotest recesses of the Himalaya.

We revert to the Norway spruce, so universally known, only to mention the vast mischief done by squirrels in plantations of this valuable tree, and to caution all planters against allowing these animals to multiply. In winter, when pressed by a deficiency of other food,

they bite off the smaller shoots over the whole surface of the tree, finding, apparently, at the gibbous base of the shoot made in the preceding summer, a small portion of pith; at least, we have never seen any but the shoot of one season's growth to be bitten off, and always to have been gnawed only at its base. Being astonished at the wide extent of the ravages committed by these animals, in a large plantation of spruces, scarcely a tree being untouched, we caused the shoots, which had been bitten off and were lying under one tree, to be collected. They filled two corn-sacks. The effect upon the specimen is extremely destructive to its beauty and its growth.

Among the firs long introduced among us is the hemlock spruce fir (Pinus Canadensis) a tree of vast growth in its native regions in North America, and of beauty so striking that we wonder it should still be rare in our gardens. In foliage it resembles the yew, but is of a light and cheerful tint, and is free from that rigidity of habit, which is the general fault of the trees of that section of the genus Pinus, which bear solitary leaves, and are generally called firs in contradistinction to the pines, which bear their leaves in distinct sheaths, enveloping more or less crowded fascicles. A most interesting fir of this section has been recently introduced into this country by the indefatigable collector of the Horticultural Society of London, Mr. David Douglas, from the north-western regions of North America, where it is found abundantly between the rocky mountains and the Pacific ocean. Pinus Douglasii, which is, perhaps, the Pinus taxifolia of Menzies, is a stupenduous tree, growing from 150 to 200 feet in height. One specimen is said, by a traveller upon the Columbia, to have measured 230 feet in height, and fifty feet in circumference. Its timber is singularly close-grained and heavy, its bark surprisingly thick, its foliage very elegant. It is quite hardy, and apparently of rapid growth. Judging from the appearance of young specimens, we deem it the most lovely of its class yet known to us. Reverting to the section, the leaves of which, like the Scottish fir, are borne in sheaths, we must mention another fine hardy tree, brought from the same regions by the same distinguished traveller, Pinus ponderosa, so named from the great specific gravity of its valuable wood. It appears to resemble the Scotch fir in habit, has longer leaves, grows rapidly, but is understood not to arrive at the gigantic stature of Pinus Douglassii. Its wood is singularly close in the grain, and of great durability, probably excelling in value that of any other species of the whole tribe; and as it appears to us to grow as fast in this climate as the Scotch fir, we are inclined to think that it ought everywhere to supersede that species. But as the whole of the individuals among us were probably raised from the cones imported by Mr. Douglas, a fresh importation is a most desirable matter, to which we invite the attention of the public. A tree well known to the Romans (Pinus Laricio) has lately travelled to our collections from the mountains of Corsica. Though its native habitation was so near to us, it had entirely escaped the notice of British collectors, till the overthrow of Napoleon introduced to them a specimen thriving conspicuously in the arboretum of the Jardin des Plantes at Paris. Since then it has been raised in considerable numbers in some of the London nurseries. It is a native not only of the mountains of Corsica, but of the loftier summits of the Grecian archipelago, and has been found upon Mount Ida. Handsomer when young than the Scotch fir, it is equally hardy, has longer and finer foliage, is of more elegant habit, produces timber of greater specific gravity, and is very deserving of the marked attention, not only of the ornamental planter, but also of the planter for

profit. Another very interesting tree from the East, introduced into the country about twenty years ago,—Pinus Pallasiana,—has been better known by the name of Pinus Taurica. In the central regions of the Crimea, on the western declivities of the mountains, which stretch along the shores of the Black Sea, this tree, called *tsaam* by the natives, forms considerable forests, and grows to a great size. Its wood is very knotty, resinous and durable, but is not well adapted to the purposes of the joiner, on account of the knottiness of its texture. It throws out its branches, almost from the base of its trunk, in a horizontal direction, and is said to be strikingly picturesque in its habit. It abounds with a resin singularly odorous, and will probably be one of the most distinguished inhabitants of the Pinetum. But the experience of Mr. Lambert has assigned to this tree a station of singular utility. He has ascertained practically its capacity of flourishing upon the most barren chalk downs, where the thinness and aridity of the soil combine to forbid almost every other tree from succeeding. A few trees which he planted at Boyton about twenty years ago, where the soil was little more than two inches thick upon a bed of hard chalk, are now nearly thirty feet high, and very luxuriant. Many were planted by the present Duke of Marlborough at White Knights. Their cones produced in this country have never perfected seeds, but it cannot be difficult to procure them from the Western Coast of the Crimea. It may be as well to remark here, that in bringing home cones of any fir, peculiar care should be had in placing the box containing them, in an airy situation, in the cabin or between the decks. The high temperature and confined air of the hold of the ship destroy the life of seeds speedily. A very magnificent pine was discovered by Mr. David Douglas in sandy plains in Northern California, and appropriately named Pinus Lambertiana, in honour of the very distinguished botanist, Aylmer Bourke Lambert, Esq., whose magnificent work on the Genus Pinus, to which we have been largely indebted, has contributed in a remarkable degree to elucidate the history of this extensive genus. It is a plant of vast size, growing in its native plains from 150 to 200 feet high: one specimen which Mr. Douglas measured was 215 feet in length, and 19 feet in diameter. The cones of this splendid tree are sixteen inches in length and nine inches in circumference. We apprehend, from some observations which we have made, that in Great Britain it can only be regarded as a specimen tree, confined to very sheltered and warm spots. But the recent and still-pending researches of the same enterprising traveller and enthusiastic botanist, in the same regions of North America, the regions which bound the Northern Pacific Ocean, bid fair to enrich the Pinetum in no common degree. In the mountain valleys of the Alps of New Albion, surrounded by snow peaks exceeding Mont Blanc in elevation, he has lately discovered several most interesting species, which must all be hardy in England:—Pinus nobilis, and Pinus grandis, equalling Pinus Lambertiana and Pinus Douglasii in hugeness of stature; Pinus monticola, two varieties, resembling in elegance of foliage the Weymouth pine; Pinus Menziesii, of smaller growth, but curious habit; Pinus Sabiniana,—are all plants of great interest, and will be acquisitions of uncommon value. We suspect that mountain trees, from elevations correspondent in temperature with the climate of Britain, will be found to succeed in it better than trees from lower regions, even when situated more northerly. The larch of Switzerland and the Tyrol countries, to the south of us, succeed better here than the larches of Siberia and Canada. The Pinus Laricio of the mountains of the genial countries of the Mediterranean is more at home in England than the

Pinus balsamea of Nova Scotia; and it may be expected that the trees of North Western America will do better with us than the trees of correspondent latitudes in the United States, where the extremes of summer and winter temperature are more violent than in the countries bordering on the Northern Pacific Ocean.

In treating of garden trees, we have omitted to mention Pinus cembra. Even in its native climate and soil, among the mountains of Switzerland, it is remarkable for the slowness of its growth, and in England the Swiss variety preserves the same character; but it is also indigenous to Siberia; and we have observed that the Siberian variety, which is not uncommon in our nurseries, makes less rapid progress than its Swiss congener. Pinus cembra, when it has attained to considerable size, is one of the most ornamental trees of the whole tribe, and should find a place upon every extensive lawn.

It would be superfluous here to discourse upon trees so well known as the larch, whose wood almost rivals the oak in durability, and whose bark is about half the value of the bark of that tree; of the Weymouth pine, whose stem furnishes masts; of the Stone Pine, whose vast canopy, supported upon a naked column of great height, forms one of the chief and peculiar beauties in Italian scenery, and in the living landscapes of Claude; of the pinaster, whose clustering cones and fine foliage entitle it to rank high among the most picturesque of its congeners; of the Mugho pine, and Pinus pumilio, whose low dwarfish growth are of great value in the picturesque arrangement of a Pinetum. There are several other species, which, though neither of size nor of beauty to entitle them, in this brief sketch, to a distinct notice, should be included in the range of a well-ordered collection. We shall, however, pause a moment to advert to Pinus excelsa and Pinus Gerardiana, both lately introduced from the regions of the Himalaya. The former is a tree of large size, growing from 90 to 120 feet high; the latter a fine tree, said to resemble the Stone Pine, and known to the natives by the name of the Neoza pine, produces an abundance of edible seeds. Several other species exist upon the Cordillera of the Andes, stretching from the northern side of the equator, through Mexico to New Albion, and at intervals rising into the region of eternal snow; some perhaps upon the mountain chains of Caucasus and of Central Asia. A few coniferous trees of other genera remained to be mentioned. A noble tree of most exotic appearance (Auraucaria imbricata) graces the more southerly plains of South America, and with slight protection endures the climate of the south of England. Another species of too tender constitution (Auraucaria Brasiliensis) is supplied by Brazil; others exist upon the shores of Australia: the noblest of all, and the fairest (Auraucaria excelsa), whose beauty and stateliness are faintly represented by a few specimens confined within the narrow limits of our conservatories, is found, exclusively we believe, in Norfolk Island, one of the loveliest spots in the southern hemisphere, (the penal station of the penal colony of New South Wales), where it rises to the magnificent height of more than 200 feet, and reaches to bulk correspondent with so vast a height. A very pretty tree, nearly allied to Auraucaria,—Cunninghamia lanceolata, —is becoming general in collections. It is a native of China, and hardy in light soils. Being always in this country propagated from cuttings, it requires some management to make it throw up a vigorous leader, and assume the habit of a tree. If, however, it be planted out in a sheltered situation, and in good soil, and if then, when it shall have made a considerable mass of roots and is well established, its shoots be depressed into a horizontal position, and so confined with pegs, it will ultimately

throw up a strong perpendicular shoot from its roots, and make quick progress. Sometimes these strong shoots, after a year or two of rapid growth, relax their speed, and discontinue the function of a leader: in such cases they must be depressed as before, and the practice will be sure to succeed at last.

The Italian cypress (Cupressus sempervirens), so conspicuous and so beautifully applied in the terraced scenery of Italian villas, cannot be said to attain to full vigour even in the south of England. It is essentially the tree of architectural gardens, and ought never to be forgotten when the climate and soil admit of its application. A tree nearly allied to it, but deciduous (Cupressus disticha of our enumeration), now separated into a distinct genus, under the name of Taxodium distichum, is one of the largest and most ornamental of all the trees which thrive in temperate climates. Nothing can well surpass the loveliness of its light and delicately-coloured foliage. Though a native of Mexico, and of the southern sections of the United States, inhabiting the deepest deposits in the valleys of their vast rivers, and luxuriating in the deadly swamps of the Mississippi, yet in England it appears to be perfectly hardy,—affording one of many instances, that trees vary in hardihood of constitution, and are not to be absolutely tested by the latitudes, or even by the elevations, where nature has originally placed them. It should have a deep, and, if possible, humid soil. When we say that no pleasure-ground should be without it, we but faintly express our sense of its elegance. Another species of taxodium (Taxodium sempervirens), an evergreen tree, exists on the North-Western shores of America, and should be introduced into this country. One, if not two, true species of cypress are known to be found on the same shores. In China and Japan several species of conifera are among the most remarkable characteristics of their vegetation. Cupressus pendula, which equals the weeping willow in the charms of its pendant branches, in China is generally planted to hang over the tombs of the departed. Nothing can be better in unison with this purpose than the dark and weeping branches of this tree. Several species of thuya, inhabitants of the same countries, are great desiderata. Among them, Thuya dolabrata calls upon us for the most earnest endeavours to introduce it. This plant is described by Kæmpfer and Thunberg, who saw it in its native soil, as a lofty, vast, and beautiful tree, of all evergreens the fairest. It is unquestionably hardy. The policy of these remarkable nations opposes the most inflexible resistance to European intercourse. Still the perseverance of individuals, and of the Horticultural Society of London, have procured us many of their beautiful plants. The camellia is the chief spring ornament of our conservatories; their magnolias, their azaleas, their pæonies, decorate our pleasure-grounds; the corchorus and the numerous varieties of the china rose, adorn our humblest cottages; but scarcely a forest-tree has yet taken its station upon our lawns. We cannot doubt that this may also be achieved. To China, to Japan, to the Himalaya, and other mountain chains of Central Asia,—to the alpine vallies of North-Western America,—to Patagonia, the hills of Southern Chili, and the archipelago of Chiloe,—we look as to the sources almost unexplored of additional wealth to the arboretum. Our intercourse with almost every corner of the habitable globe is so intimate, communications with the most distant nations are so frequent, so many accomplished individuals inhabit countries the most remote, that we are persuaded it is only necessary to invite general attention to our favourite object, in order to place it in a fair train for accomplishment.

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THE END.

London: W. Clowes, Stamford Street.

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Th. ed.

A

# PRACTICAL TREATISE

ON THE

# BEST MODE OF REPAIRING ROADS,

WITH

## SOME OBSERVATIONS UPON THE PRESENT SYSTEM.

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By CHARLES PENFOLD, Surveyor,
CROHAM, CROYDON.

A

# A PRACTICAL TREATISE ON ROADS.

The art of road-making is of daily increasing importance, and as the attention of the public is directed to the subject so will its utility be appreciated. Few years have elapsed since it was considered below the notice of persons of science and education; and had not the exertions of some eminent men, such as Telford and M'Adam, excited the general attention of the country, and shown how much benefit might be obtained by a judicious application of labour, our roads might have remained in the same imperfect state which they exhibited before that period.

The improvement, however, is only partial, and chiefly on the turnpike-roads; while the generality of those under parochial management continue in a defective state, although a much greater amount of money and labour is annually bestowed upon them, than would be sufficient to maintain them in complete condition. Want of knowledge occasions a useless expenditure. Materials are selected without discrimination; they are not broken to an uniform size; they are carted, at vast expense, to places already supplied to excess; no attention is paid to drainage; and labourers are paid by the day, instead of by the piece.

The object of this essay is to show how good roads may be obtained at a less expense to the country than is now incurred in keeping up the rough, rutty, and misshapen ones. In effecting this desirable end, the able-bodied labourers who have hitherto sought for employment, and sought in vain, would find a market for their labour, and the poor's-rate, consequently, be greatly relieved. Money has hitherto been thrown away in the purchase of unnecessary materials and horse-work, when *manual labour* only was required; and the expenditure would be turned into a direction, under the new system of repair, which would not only relieve the poor's-rate, but *reclaim men from pauperism*. When a man is employed by the surveyor he is no longer a pauper, he is at once independent, and giving value for what he receives. Under the present laws relating to parish roads, and by which parish surveyors are appointed, instead of the repairs tending to find independent employment for the able-bodied, the amount of pauperism has been increased. Instead of the parish surveyor employing labourers himself in digging his materials, and treating them as men giving value for the money they receive, the overseers have been the parties to employ them, and have made them paupers. Every load of gravel dug upon this system cost ten times as much as men would have dug it for employed by the surveyor, and paid by the *piece*. Nothing can be gained by assembling a large body of paupers in a gravel-pit, to countenance one another in their endeavour to do as little work as possible, and to concert schemes for riot and debauchery. It is far better for the surveyor to employ them as independent workmen, and give them a fair value for their labour, and to pay them only for what they do, under the proper system of piece-work.

It is distressing to any one to reflect upon this subject, who is well acquainted with all its bearings, and to see the same system continued year after year, when an alteration might be made which would remedy the evil. A more beneficial mode of employing the able-bodied labourers

of this country cannot be pointed out than the maintenance of the highways; which would at the same time be advantageous to the country in general, and promote the independence and comfort of the labourers themselves.

That part of the present system which is called Statute Duty is one of the evils that militate against the possibility of keeping the parish highways in repair, well and sufficiently, at the least cost. It had its origin in days long gone by, when all persons, with their horses and carriages, were commanded by the King to lend their aid in making the highways passable for his Majesty's troops. It was afterwards made a compulsory duty, and the proportions to be done by each person were settled by Parliament, and therefore called Statute Duty. This mode of levying contributions towards the repair of the highways is highly objectionable, and should give place to an improved principle, which will be just to all parties. The system of statute duty is this: when a rate is made for the purposes of the highways, every person keeping a team, or renting 50*l.* per annum, is liable to do as many days' work as may be required by the surveyor, not exceeding six. If he do not keep horses, he must pay money in lieu of work. He must pay the amount which is fixed upon by the magistrates at Michaelmas. For example, if the price fixed be 15*s.* per day for a team, he must pay that amount as many times told as the surveyor requires days' work, and again for any additional team or 50*l.* rental; so that if a person do not happen to keep horses, he must pay in money the full amount of the work which he should do. Now, see the injustice of the system of statute duty: the work being executed by the day, and not by the piece, instead of the 15*s.* worth being done by those who keep horses, it will be found, as it always has been found, that not more than 7*s.* worth of work is done; so that the one party pays 15*s.*, when the other only contributes 7*s.* This arises from the statute duty being day work, and it has such a tendency to injustice, that it ought to be done away. The principle also upon which it is calculated is so confusedly arranged and expressed, as to render it almost unintelligible to the generality of surveyors. It may be said, indeed, that but in very few instances is the act of parliament in this respect complied with. The practice under the present law of choosing men entirely ignorant of the art of road-making, and whose interest is adverse to a proper execution of the law, at once shows how little skill is considered necessary for the purpose. There surely are not any instances in this country where a tailor is employed as a sculptor, or a shoemaker as a watchmaker; yet such persons are often appointed as surveyors of the highways, and so long as the present law continues will these absurdities take place. What is the consequence? From want of knowledge of his subject, the surveyor so appointed considers that if a road be full of holes, he has nothing to do but to fill them up; the larger the stone the stronger he thinks it: and the holes are therefore filled with large materials, sufficient, indeed, to shatter a wheel that is slightly made. He has no idea that there are at present in the road huge stones enough, if picked up and broken, to last for years to come, his only notion being that the holes are caused from want of more materials; and thus he spends his resources in *horse*, instead of *manual labour*. Those horses would be much better employed in giving an extra ploughing to the farmers' fields; and the poor labourer would be much better employed in picking the road up, than in standing at the door of the overseer for money which he has not earned.

But the whole management of parish roads, with few exceptions, is of a piece with this. It is not necessary to enter into every particular in

which it is evidently defective. Reference to the state of the roads themselves, and the amount laid out upon them, will quite fill up the omission. There is no reason at all why every mile of road in this country should not be made good—not the turnpike-roads only, but every mile of public road. The money that has been given to the able-bodied in the shape of relief, and for which little or nothing has been returned, would have effected this long since; but the present law stood in the way of so desirable a result, and the poor have consequently been looking on in idleness, and become demoralized. The moving power was wanting, not the machinery. Had the law been such as to secure the *management* necessary, the effect would have been produced.

The writer is much pleased to find that his notions upon the subject agree with those of so high an authority as Sir Henry Parnell. The following are his observations on parish roads:—"The roads commonly called parish roads in England are generally in an imperfect condition; this is owing chiefly to the law by which the management of these roads is placed under the governing authority of the vestries of the parishes through which they pass. Blackstone says, 'In England every parish is bound of common right to keep the roads that go through it in good and sufficient repair, unless by tenure of lands or otherwise the care is conveyed to some particular person.' The principle here established, of placing the common roads of the kingdom, not being turnpike roads, under as many separate governing authorities as there are parishes, is in every respect repugnant to anything like a sound principle of management, and until it be abandoned no efforts of legislation can prove successful in introducing any real improvement. So long as this radical error shall be acknowledged by Parliament, it will be labour in vain to pass acts of parliament containing a multitude of new regulations. The influence of the original cause of the evils which prevail, will render them, as they have rendered hundreds of similar regulations, wholly abortive. Legislation on the highways of England, to be of practical good, must be founded upon a more enlarged view of the subject, and instead of the governing authority of a parish, it seems advisable that that of a county should be substituted; or when counties are very large, that of a division of a county.

"The reasons which may be given to support this general proposition are so obvious, it is unnecessary to state them all in detail, two only will be noticed. The first is, the private interests of a vestry lead it to be satisfied with very imperfect roads. A road that will allow a waggon to be drawn upon it without much difficulty will answer the purpose of those who compose the vestry. But such a road need not have any other qualities than two ruts for the waggon wheels, and a trackway for the horses. The second reason is, that the limited extent of the funds of a parish will not admit of giving such a salary to a surveyor as will secure the services of a person educated in the principles of road management, and otherwise qualified for the office of surveyor.

"The next great error in principle as to legislation on the common highways is, the means by which the funds for maintaining them are provided; namely, statute labour; and it may be said upon this point, as it has already been said on the former, that so long as this radical error in principle shall be recognised by Parliament, it will be labour in vain to pass new acts to remedy existing evils.

"A third great error in the system of parish management consists in the regulation by which a surveyor is appointed to act for only one year. This practice is founded on the vulgar notion, that the management of roads is something that requires no education—that it is not an art which requires

skill and science. This practice may be set down as one which had its origin in very rude times, and which long usage has made familiar, but it certainly is one which ought to be abolished in the present enlightened state of society. To legislate, therefore, on sound principles, the old custom of seeking to mend what is wrong by laws containing a multitude of new regulations, must be abandoned. The country gentlemen, who, as members of Parliament, undertake the task of legislating on the subject, must look more to general principles; and to succeed they should no longer act upon the principle of making parish vestries the governing authority, the principle of acquiring funds for the maintaining the highways from statute labour, and the principle of appointing annual surveyors."—Page 309.

It will be as well here to point out in what way the amount raised for the repair of parish roads is disbursed, and how it would be applied under the new system. According to the returns made to Parliament in 1814, and alluded to in the Report of the Select Committee of the House of Commons on County-rates and Highways last year, the sum of 1,500,000*l.* was raised for this purpose. Now, Sir James M'Adam, in his evidence before that Committee states, that the average expenditure in the two items of horse and manual labour, for the two years previous to his undertaking the Epsom roads, was, *horse labour*, 1044*l.*; *manual labour*, 359*l.*; and that under his management the proportions for those two items varied as follows, viz.: *horse work*, 227*l.*; *manual labour*, 1146*l.* The million and a half expended upon the parish roads may be divided into the following items, viz.:

| | |
|---|---|
| Materials, tradesmen, and officers | £500,000 |
| Manual labour | 250,000 |
| Cartage | 750,000 |
| | £1,500,000 |

Giving the same proportions to the two items of labour as Sir J. M'Adam found to be in practice on the roads alluded to, and which are the proportions generally throughout the country.

Under the new system the items for horse and manual labour, upon the authority of the evidence before quoted, would be thus varied, viz.:

| | |
|---|---|
| Manual labour | £833,000 |
| Cartage | 167,000 |

The excess of manual labour to be employed under a good system of management then would be 583,000*l.*, supposing the same amount to be expended as heretofore, which would be the case until the roads were brought into a good state of repair. But so great an outlay, it is contended, after a year or two, would not take place, and the assertion is grounded not only upon reason, but experience and trial.

The reason will be found upon the perusal of the following essay, which it is hoped plainly points out why a saving *must* take place under an efficient management; and the inefficient management of the present system is evident from its ill effects, and from its being the reverse of that which is adopted where expenditure is saved.

The writer has had the care of parish and turnpike roads for years, and by following the principles laid down in this work, he has effected a saving in expenditure to the following amounts:—Upon the parish roads of Croydon, from 1047*l.* 16*s.* 5*d.*, which was the average annual outlay of four years, to 485*l.*, which was the average annual outlay of the succeeding four years. Again: upon the portion of the Surrey and Sussex roads lying between Croydon turnpike-gate and the bridge at the entrance to Streatham parish, the Trust assigned 1000*l.* a year as the amount to be expended

upon that portion of their roads; and lately, upon an estimate made by an eminent road surveyor, with the view of apportioning the sums to be expended on the various lines of that Trust, he assigned 830*l.* as a fair amount of outlay to be made on that line. The writer, however, has kept it in repair for the sum of 554*l.* 6*s.* 3*d.* upon the average for the last three years*, and since that estimate was made. Knowing, therefore, that proper management will assuredly effect a saving in the amount to be expended, it may fairly be said, that out of the million and and a half hitherto laid out under the old system, 500,000*l.* may be calculated upon as the sum which the country would be relieved of in the actual amount to be collected under the head of highway rate, after the roads are brought into a good state of repair.

During the time of converting the roads from their present state into the state in which they ought to be, the expenditure will continue the same in amount, but the items of it must be varied as before shown, viz., instead of 250,000*l.* only being expended in manual labour, and 750,000*l.* in horse work; 833,000*l.* would be expended in *manual* labour, and 167,000*l.* in *horse* work. The difference, then, between 833,000*l.* and 250,000*l.* will be saved in the poor's-rate, *i. e.* 583,000*l.*

The sum of 500,000*l.* of the old expenditure, which has been set down for *materials, tradesmen, and officers,* it is calculated, would remain the same for the first year or two, whilst the roads are being brought into a proper state, but varying the items of which it is composed, *i. e.*, although the amount expended for *materials* will be very considerably less, the outlay for tradesmen's bills and management will be greater; but taking them together the total would be the same. After the roads are reclaimed from their old bad state of repair, it has been shown that the outlay will be reduced from 1,500,000*l.* to 1,000,000*l.* It is necessary, then, to show in what way the money will be disbursed, because after the roads are once made good, the items of expenditure change materially. As it is the writer's desire to come at the truth, and not to put a false colouring upon the statement, it is proposed to enter into the detail of the outlay in every point of view.

In the first operation of reclaiming the roads, but few materials and but little horse work are required, the expense consisting chiefly in *manual* labour and tradesmen's bills. When once this desirable object is accomplished, although the total cost is less in the proportion named, the items vary, and would be found, from experience, to be in the following proportions, viz.:

| | |
|---|---|
| The manual labour would be . | £402,000 |
| Horse labour . . | 228,000 |
| Materials, tradesmen, and management | 370,000 |
| | £1,000,000 |

We then have a saving in the highway rate to the amount of 500,000*l.*, and although the saving would not be so great in the poor's-rate, *after the roads are in a good state of repair*, because so much manual labour will not be required; yet even then there would be an excess of labour employed to the extent of 152,000*l.* This sum, then, will be saved in the poor's-rate constantly, and half a million in the highway rate, with the roads in repair equal to the turnpikes, and all the cost of management defrayed. Whether this be a fair deduction from the premises, the reader will judge; but that the additional quantity of employment above stated

* A reduction to this amount, it is confidently felt, can be effected in most of the roads in the kingdom, where the principles herein described have not been followed.

will be found there can be no doubt. It is not probable, then, that the people would long object to an alteration in the law, when their interest is so much concerned in it. It is one of those alterations, however, which must be provided for and defined by the Legislature.

It cannot be accomplished if left to the option of parishes. It must be effected by *consolidation*, by *districts being formed*, by *Boards of Management*, and *able officers*. By, in fact, composing a new highway system upon an enlarged view of the subject.

The principles which should be followed in the repair of public roads will now be described.

This essay treats more of road repairing than of road making *de novo*. The desire is to lay down rules by which the *parish roads* of this kingdom may be reconstructed.

Although the same principles will apply to turnpike roads, yet these cannot be said to be so entirely mismanaged as the other description of roads. In the one case, there are trustees acting constantly to control and direct the affairs of the turnpikes, and chosen officers continued year after year. But in the other case, the surveyor is unpractised, and altogether unfit for the office; with no one to guide and assist him during the continuance of his year of service.

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## PRINCIPLES TO BE FOLLOWED IN REPAIRING OLD ROADS.

### FOUNDATION.

Attention must first be drawn to the foundation of the road. Men, eminent for their skill and practical knowledge, differ upon this point; the one party contending that a *pitched* foundation is necessary to make a substantial and good road; the other, that no pitching * is essential. The one says, that you cannot make it *non-elastic* without the pitching; the other, that the pitching is so much expense needlessly incurred.

It would seem that the latter is the most reasonable conclusion. The pitching is either unnecessary, or mischievous, when the body of the road is to be constructed of a *softer or more brittle material*. For if a more brittle material be laid upon one of a stubborn nature, and where there is not thickness enough of the inferior sort of itself, or of its own weight, to support the loads it is subject to, that material, lying between two hard substances, must be pulverized. The heavy waggon-wheel above, and the hard pitching-stone beneath, place the flint or gravel in a situation similar to the wheat between the miller's grinding-stones. If, however, there be a thickness of materials upon the road sufficient to preserve them from this effect, the weight of the flints themselves will form power enough to compose the road, without the solid assistance of the pitching-stones. The plan of a pitched foundation could only have been resorted to where the funds so abounded as to allow of such an extravagant proceeding.

It perhaps may be conceded, that upon a road which is liable to great and heavy traffic, and where there are ample funds at hand to supply the expense, and in order to render security doubly sure, the practice may be resorted to. But then it must be qualified by an undertaking that as great a thickness of broken metal be always kept up upon this pitching as to secure the upper substance from being sacrificed.

The best foundation for a road is a substratum kept perfectly dry by

* Pitching is a foundation formed of large stones.

proper and effectual drainage. Secure this, and it forms a basis for the materials to rest upon, far more economical, in every respect, than the pitching stones; first, in the prime cost of it, and, secondly, in the diminution of wear. As to the elasticity, or *giving* propensity in a road, made without pitching stones, nothing need be apprehended; for with a subsoil drained, and a competent thickness of the common materials kept up, elasticity vanishes.

Besides, in a pitched foundation some of the stones would be liable to sink deeper into the subsoil than the rest, and would consequently cause holes to appear in the surface, which would not occur when a body of flint broken small is the substratum.

If one substance used in road-making be harder than another, that substance should be upon the surface, and not at the foundation; to lay the softer upon the harder, must have the effect of sacrificing the inferior material. If the pitching-stone be of a softer nature than the materials to be laid upon it, the objection to its use will not then apply.

## DRAINAGE.

Next in order comes drainage. No attempt at repair must be made until great care has been bestowed upon this point—a point so desirable in road-making, that any exertion in other respects will be fruitless when this is unattended to. Of what service can metal be when the road is immersed in water? Can it consolidate? Can it form a compact and hard substance when water is amongst it, consuming as it were its very vitals? Water in a road is as the canker, inwardly fretting and destroying the very principle of life. Assistance then must be given by the hand of skill—the intrusive, unwelcome visiter must be shown the door. To effect this, let the ditches be examined, and if found not to be sufficiently below the foundation of the road, they must be cleansed and lowered, and a ready fall secured leading from the road. If the fall be slight, create if possible an artificial one. If the subsoil of the road contain springs, find them out, and fear not to cut well into them, laying an under-drain of tiles or blocks of chalk, or large pieces of stone or bricks, from the point of the spring into the ditch. If this be not done, the road in those places will be constantly sinking into holes and soft places, and consume more materials in a year than the expense of the under-drain will amount to; but the under-drain will last for years, and the roads be always sound. Outlets from the watertables into the ditches cannot be seen in too many places: if they be not attended to, the water which falls upon the surface of the road cannot escape, and must have a bad effect. It will very often be seen, that the lands adjoining are situate upon a higher level than the road, and when this is found, water will have a natural tentency to pass through and across it.

In these instances, if there be no ditch to intercept the water, there must be one made, or an under-drain along the watertable, or under the footpath, formed, as before described, of chalk or stone, that the foundation may be preserved. When a particular piece of road is observed to be continually heavy and in a bad state, requiring a coat of materials constantly repeated, it is situated either in that manner, or in a flat, where the water cannot escape. There are very few instances in which relief may not be afforded by drainage; and a careful observer will find how immediate the relief is, and how much wear is saved when effectually conducted, and how improved the road becomes with respect to the draught for horses. It will be found that drainage is less attended to upon parish highways, than even the general course of repair by gravelling, &c.

It is not necessary to say more upon this part of the subject than to repeat, that before any other step be taken towards repairing a road, the drainage must be made perfect, or all efforts, in other respects, will be labour in vain.

### THE SUBSTANCE OR THICKNESS OF MATERIALS.

Without a sufficient depth of consolidated materials there will not be a resistance equal to the weights which a highway is subject to. There must be weight to resist weight. This may be regulated by the degree of consolidation which the body of the road has, by skill, acquired. If the weight of metal forming the substance be of an imperfect quality, more will be required than when sound and clean. In proportion to the quantity of deleterious matter contained in the body must the thickness be increased. Any matter that is not of a sound nature has no power in road-making, and, therefore, the hard materials alone contained in the road's substance can be calculated upon as possessing the quality to resist weights.

If an inefficient thickness of good materials be allowed to continue for any time, the result must be a heavy and imperfect state of road. The power will not be equal to carry the weights, and the condition of the surface will be worse and worse, until the whole body will be cut through, ploughed up as it were, and become impassable. It will be beyond the skill of any one to keep a sound road, when the strength is unequal to resist the passing pressure. Experience has taught, that there can be no real security against a road giving way, taking the year through, unless twelve inches at least of good sound consolidated materials form the body of a road; and this upon a foundation rendered sound and dry by effectual drainage. In many instances, there may be less substance than this, and the surface may appear perfectly sound and level to the eye; but in the event of a severe winter such a state of things will speak for itself. It will make itself manifest by the *blowing up* of the road at the giving of a long frost; when parsimony will prove itself to be but foolishness. Provide, then, the degree of substance before mentioned, and rest satisfied that enough has been done in this particular.

### SORT OF MATERIALS TO BE USED.

It is obvious that a surveyor in the choice of the materials with which he would construct or repair a road must be mainly guided by the expense at which he can procure such materials broken and thrown down in the situation in which they are to be used. The ability to ascertain the strength and durability of each sort of stone, so as to form a correct estimate of their comparative value, is one of the chief qualifications of a road surveyor. It is a ruinous economy often practised to use soft stone, because it may be obtained near at hand, and at a third of the price of a strong stone which may be brought from a somewhat greater distance; and sometimes from an ignorance of the qualities required in a road-stone, inferior materials (as flint) are preferred, when superior materials (as whinstone or basalt) may be obtained at equal, or even less cost. We shall now offer some rules for the guidance of road-improvers on this head, laying down first the principle on which the selection ought to be made, and afterwards illustrating it by reference to particular kinds of stone*.

"There is (says Sir John Herschel, in his Discourse on the Study of Natural Philosophy, par. 257.) a certain degree of confusion prevalent in ordinary language about the hardness, elasticity, and other similar qualities of solids, which it may be well to remove. *Hardness* is that disposition of a

* The Author is indebted to a friend for much of this section.

solid which renders it difficult to displace its parts among themselves. Thus, steel is harder than iron, and diamond almost infinitely harder than any other substance in nature. The *toughness* of a solid, or that quality by which it will endure heavy blows without breaking, is again distinct from hardness, though often confounded with it. It consists in a certain yielding of parts with a powerful general cohesion, and is compatible with various degrees of elasticity." The confusion of which Sir J. Herschel here speaks, between *hardness* and *toughness*, has led to serious practical errors in the choice of materials for roads, inasmuch as the attention has been often directed exclusively to their hardness, without any regard being had of their toughness. If roads were only exposed to the friction, or to what is usually called the *grinding* of the bodies moving along them, the quality of hardness would be sufficient; but as the surface of the road also supports their weight, and is subjected to their *pounding* or *crushing* action, it is necessary also to take the toughness of materials into the account. The latter quality is in fact far more important than the former, inasmuch as the pressure of heavy weights affects the entire substance of the roads, dislocates the stones, produces inequalities of level, and entirely destroys some portions of the material; while the wear of the wheels merely affects the surface and grinds the face of each stone by a slow and regular process. The importance of toughness in a road-material may be illustrated by supposing a road to be formed of pieces of glass, a very *hard*, but extremely *brittle* substance; it is manifest, that under the pressure of heavy weights such a road would be crushed to powder in a few hours. A mistake, similar in kind, though less in degree, has been committed by those who have thought that flint is a good road material, because it is *hard*, the fact being, that is not a good road material, because it is *brittle*. Another quality desirable in a road-stone is, that it be as far as possible homogeneous, or of a similar texture throughout; as, if one of the component parts is weak, the stone will crush, although the other component parts may be strong. Granite is an instance of this, as its felspar, especially if well crystallized, is easily pulverized, although the hornblende is hard and tough. The superiority of tough stones which do not readily crumble under pressure is manifest; not only do they form sound and even roads, with little mud in wet weather, and with little dust in dry weather, but (as Mr. DelaBeche* has properly remarked) on account of their durability, they lessen "the amount of hinderance caused by the more frequent supply of rough new stones, which tend so much to retard the progress of wheel carriages, and add to the labour of the horses that draw them."

For ordinary purposes, Mr. DelaBeche suggests that the best means of ascertaining the comparative toughness of stones is to pound equal pieces of equal size. In general those stones which are most easily broken into small pieces with a hammer are those which are least fitted for roads.

The mineralogical character of rocks comprehended under one geological denomination often differs so widely, that it is difficult to lay down any rules which shall be universally true of any kind of stone. The following remarks will, however, be found of tolerably general application.

The trappean and basaltic rocks are those best suited for the construction of roads. No material has ever been used superior to the tough basalts, which are brought in ballast in ships from China and Bombay, and which have been partially used in the Macadamised streets of London. The whinstones of Northumberland, and the dark basalt of the Clee Hill in Shropshire, are almost perfect as road-stones. Among the granites, the Aberdeen, the Guernsey, and Dartmoor are preferable to that of Corn-

* How to observe, p. 300.

wall. Indeed the darkest in colour are invariably the best, as containing a greater proportion of hornblende, which is tough, than is found in those of lighter colour, where the brittle substances of felspar and quartz are the chief ingredients. Limestones in many respects afford an excellent material; but, excepting the carboniferous and some of the transition limestones, against which little objection can be urged, they have several defects which partly counterbalance their merits of smoothness of surface; they are too tender for the *support* of heavy weights, and are so slippery after wet as to cause frequent and unavoidable accidents.

It will be hereafter remarked, that the more unyielding the material, the smaller is the size to which it ought to be broken; while soft stones may be safely laid on a road in larger pieces. Limestones, however, have in general a peculiar quality of making smooth roads, even if not broken to a small size, probably on account of the binding and cementing power which they possess. Pit gravel, especially that belonging to the new red sandstone formation, is in general not to be depended upon, as containing stones of different sorts, and consequently of different degrees of strength. The gravel of the chalks and other soils in the southern part of England consists, however, almost entirely of flint; which, as has been above remarked, is too brittle to form a good road-stone. In places, however, too remote from water-carriage to admit of any substitute being obtained at a reasonable expense, the following rules for the use of flint pebbles may be observed:—

In the first place cleanse them of all dirt and useless matter by sifting. Then separate all the large from the small stones by a like operation; but through a coarse sieve having the wires an inch asunder from centre to centre. Break every stone that will not pass the sieve, so as to reduce it into angular pieces. Lay on the unbroken pebbles first, but by no means in large quantities. Upon them put a moderate quantity of chalk, if it can be obtained, equal to about a fifth part of the quantity of pebbles laid on. When the pebbles and chalk have worked together awhile, spread the angular pieces over the whole. Too great space of time must not be allowed to elapse before the broken pebble be laid on, or the surface will, perhaps, have become too hard to admit it, and an unnecessary waste will occur before incorporation takes place. Some of the hardest surfaces have been made in this way, with chalk and pebbles, and they answer well for the summer season and open weather; but in frost *blowing up* must be expected in proportion to the quantity of chalk used, and the coldness of the weather. This will not happen every winter; and when it does occur, does not last for any length of time. Of two evils, however, the least must be chosen. It is more desirable to have a sound hard surface for fifty weeks in the year, and two weeks of bad, than to have a loose pebbly road during the whole year.

When the road is *blown up*, the only thing that can be done, whilst it continues, is to keep it raked level; and when the frost is gone, to re-form it by lifting. It is probable that although the blowing up has caused temporary inconvenience, it will end in a still sounder road being produced, if properly managed.

### PREPARATION OF MATERIALS.

Great negligence or want of skill is shown upon parish roads, in the preparation of materials before laid on the road. There are, at any rate, but very few exceptions to this assertion, and they are only to be found in those cases where enlightened gentlemen, from the interest they feel in the subject, undertake the office of parish surveyor.

In general it will be seen, that materials are brought to the road in large

quantities, and of a great size, full of dirt, clay, and other pernicious matter. They are not broken, but large and small, round and angular, in one promiscuous mass, are shot down upon the surface. It sometimes happens that a surveyor, rather more nice in his operations than the rest, will break a few of the largest size, but no farther: the mass of mixed substances is left to form itself into a road, as chance may place it or as it may be urged or worked into a settlement by the action of passing wheels. Much of these ingredients is of a nature to be very injurious to a road, and cause it to be in a heavy and dirty state, forming a great impediment to the traveller. See also what has been done by such a practice! Expense has been incurred in the purchase of this trash, in the carting (perhaps for miles), spreading, &c., and when it is on the road, instead of causing any improvement, it has rendered the condition of the surface worse than it was before. The evil does not end here, as additional expense must be incurred to have it scraped off again. Now the remedy is very simple. Suppose the material to be gravel, which by some persons is called pit-flint: let it be dug and sifted, in the first instance, through a three-quarter inch sieve, *i. e.*, a sieve having the wires at the distance of three-quarters of an inch from centre to centre. When so far prepared, let it be broken by persons in a sitting posture with small hammers, and to such an extent that no stone shall be larger than two inches. When so broken, procure sieves having the wires one inch and a quarter from centre to centre, and let the gravel be sifted through them. This operation will be the means of sorting them.

The largest size should be laid on in the winter, in any moist or bad situation, it being first ascertained that no stone exceeds two inches. If it should appear to have been ill broken, a two-inch sieve must be at hand to sort, as no stone of larger dimensions ought to be laid on a road. All that passed through the inch and quarter sieve, when required for use (which should be in the spring, as the last coat for the season), must be put into the three-quarter inch sieve, when being put into the cart. This will cleanse it of all pernicious matter, leaving nothing but stone to go on the road. It must not be urged that a waste of materials takes place by this last sifting, because that would be but a poor argument against the practice. The small portion of useful substance which will pass through the three-quarter inch sieve, is of no value to the road, and, when compared to the improvement which takes place in the quality of the gravel owing to the sifting, it ought not to bear a moment's consideration. These siftings will make excellent stuff for the footways, and if of a bright colour are of value for gardens.

To some persons the process here described will appear to be expensive and tedious, but unless it be adopted, a road cannot be made good and cheap. Upon examination and experience, it will be found to cause *as* much less annual expenditure in the repair of a road, *as* the road itself will be superior to the old ones. Let us see what the expense of preparing the materials according to the plan described will amount to.

The old method used to be, to sift once (although not even once in all cases), which brought it into the same state as it is in by the new mode, before being broken. Then, when the rate of wages is two shillings a day, *pit gravel* of the average degree of quality, can be broken for sixpence per cubic yard, so that no stone shall be larger than two inches. The price paid for sorting through an inch and quarter sieve has been two-pence per cubic yard, and the next additional expense is for an extra man when loading, that the portion which passed through the inch and quarter sieve may be cleansed by screening it again in the three-quarter inch sieve, and will

amount to one penny a yard. These three items of expense amount to nine-pence per cubic yard. For this sum the materials are brought into a state perfectly proper for making a good road.

Now if the ill-prepared materials could make a good road, this expense, of course, ought to be avoided, but as that has been found, from woful experience, to be impossible, the practice here laid down ought to be resorted to.

It is believed that few surveyors, even of reputation, take *so much* pains in this particular as they ought to do, and yet they make passable roads; but it does not follow that if more care and nicety were shown, their roads would not be still better, and kept at less expense. It is confidently asserted, from experience, that their practice would be more reasonable and economical, were they to follow this course of preparation and sorting: first, because it is evidently wrong to lay on dirt, to be under the necessity of scraping it off again; and, secondly, because it is desirable, in order to prevent unevenness of surface, to lay on materials of one uniform size, whether that size be larger or smaller.

When the expense of the old system, as far as regards materials only, is rightly calculated, it will appear that as much cost has been incurred for a pernicious or useless substance, as the labour of preparing and sorting amounts to. Let it be considered, that if a cubic yard of gravel, delivered on the road unbroken in both cases, cost two shillings and sixpence, and in its unprepared state it contain only one-tenth part clay or dirt, this would amount to three-pence out of the two shillings and sixpence. Now it has been shown, that for this three-pence the gravel can be sorted and sifted, so as to cleanse it of this matter. The money, therefore, which has hitherto been paid for worse than useless material, is, by the practice herein described, expended in rendering it fit for making a sound, good, and clean road. In this comparative statement, the expense afterwards necessary to be incurred in scraping off the dirt brought upon the road by the old system, is left out of the question; but the reader's own imagination may conceive the difference of expense which must arise between the two courses. Attention must, therefore, be paid, in a most decided manner, to the preparation of the materials in the way described, not only to save expense, but in order to produce the most perfect state of repair.

### SIZE OF MATERIALS.

It has before been said, that no stone should be larger than two inches; but this remark applied only to gravel, or other brittle substance. The tougher the nature of the material, however, the smaller the size should be. Granite broken to the size of an inch cube, must make a more durable and better road than if broken to the size of two inches: upon this principle, viz., the weight of a cubic yard of granite in a solid stone is forty-two cwt.; when broken to the size of three inches, it loses more than half its weight. Nevertheless, when once the solid stone is broken, the smaller the pieces into which it is divided, the more it approaches the solid stone again; consequently, the more minutely you break the materials, the greater will be the weight of the cubic yard; because there will be more stone in it, and a smaller portion of interstices.

The interstices, when the material is on the road, become occupied by matter of inferior and pernicious quality, such as mud, water, &c., and, therefore, the more nearly you approach the solid the better. If the thickness or depth of substance of road should be twelve inches, surely it is better to cause that twelve inches to be composed of as much granite, or hard material, as possible; and the way to effect this, is to bring it as near to the solid stone as you can, by breaking the pieces into minute parts. You

will approach then to the solidity of the paved streets, with the advantage of having your surface cemented together, instead of its being liable to be disturbed by the displacing of the separate stones.

It has been laid down as a principle, that "the tougher the nature of the material the smaller the size should be;" because if a brittle substance, like flint, be too minutely broken, or rather if it be struck with a hammer beyond a certain point, it will fly into powder. It is upon this account that directions are given to break flint or gravel, so that no stone be larger than two inches. In reducing them to this size, there will, of course, be many stones of much smaller dimensions, but there should be none larger. If they be larger, and the materials not sorted, but laid on all promiscuously together, the large stones will appear above the general surface of the road as wear takes place; and, on the other hand, if sorted, the larger size will, upon the principle before laid down, not form so solid or good a road as when broken to the proper dimensions. There are many kinds of flint and gravel, some more elastic or less brittle than others; and it is necessary, therefore, for a surveyor, before determining upon the size to which he will have them broken, to examine into the nature and quality of them.

### QUANTITY OF MATERIALS TO BE LAID ON AT ONE TIME.

This is a point of great consideration, and one in which the greatest error in management is shown. The extreme importance of this part of the art seems to be overlooked, not by the commonplace and inefficient officers only, but by many of the most zealous and able surveyors. It is the practice of the first and most eminent men in this department of useful science, to lay on materials of several inches of thickness in one coat, without even opening the surface to receive them.

We contend, from reason and practice, that such a course of proceeding is altogether extravagant, and has a bad effect. It should not be followed under any circumstances; not even where there is too thin a substance of road, and where they are laid on with the view of increasing it, or bringing the road up to its proper point of power.

When a thick coat is laid on, the destruction of the material is very great before it becomes settled or incorporated with the road. The stones will not allow each other to be quiet, but are continually elbowing one another, and driving their neighbours to the left and right, above and below. This constant motion has the effect of wearing off the angular points, and of producing mud or dirt, and of reducing the stones to a circular form. When in this state, their chance of becoming fixed and incorporated is in a great measure done away and destroyed; and the road is consequently never seen in its proper shape. Whenever pressure is applied the stone yields, and instead of the carriage passing over it without injury, it is constantly upon the fret and wear, and in a short time more material is considered necessary.

It is one of the greatest mistakes in road-making that can be committed, to lay on thick coats of materials, and when understood will be no longer resorted to. If there be substance enough already in the road, and which, indeed, should always be carefully kept up, it will never be right to put on more than a stone's thickness at a time. A cubic yard nicely prepared and broken, as before described, to a rod superficial, will be quite enough for a coat, and if accurately noticed, will be found to last as long as double the quantity put on unprepared and in thick layers. There is no grinding to pieces when so applied; the angles are preserved, and the material is out of sight and incorporated in a very little time. Each stone becomes fixed directly, and keeps it place, thereby escaping the wear and fretting which occur in the other case.

Supposing it necessary to increase the substance of road, and it is intended to apply materials for that purpose, and not merely to make good the wear and tear, it should be done in like manner by thin coats. As soon as one is embodied, apply another and another, until the desired power be obtained, but by no means put the whole thickness on at once. When that is done, the road remains in a loose, unsettled state for a tedious time, rendering the draught distressingly heavy and annoying to the public, with a great loss of material, as before described. Besides which, the sections will be found, when the metal is at last embodied, very imperfect. The wheels will have followed each other in a line, causing ruts and irregularities. The sides will have become worn down before the centre of the road, and the surface generally will present anything but a true and even section. It will also be loose, and composed of the small particles of the material which itself has caused, and when much labour has been bestowed in scraping it off, the substance will be found not to have increased in proportion to the quantity laid on.

The point to be obtained is, a hard crust or surface, which is to come into immediate contact with the tire of the wheels; a surface which will cause as little friction as possible, when pressed upon by the passing weights. This, then, by the one practice, can be effected in a much greater degree than by the other. By preparing the material as before described, there will be nothing but the clear stones to be laid on; and by opening the road to receive them, and putting a coat of a stone's thickness at a time, no grit is produced. The stones form a new crust, composed of nothing but hard substance; and the consequence is, that much less opposing matter is presented to the wheel, and the draught is therefore lighter. When the draught is lighter, the wear and tear is less, and the result is, that the slight coat will last as long as the expensive thick coat. Which is the most desirable practice must be obvious to every one.

### LIFTING.

Of the utility, indeed, of the absolute necessity of this operation, no doubt can be entertained by any one who has once put it into practice. It will be found of the utmost importance in dealing with *parish* roads, which, for the most part, have scarcely a true section in them.

Supposing a road is to be put in order which is found to contain a vast quantity of large flints or stones, which from time beyond the memory of man have lain there undisturbed. The form of the road is hideous to view, and absolutely dangerous to travel upon. In some parts one side of the road is a great deal higher than the other, containing immense obstacles to your passage, in the shape of hillocks of stone, from the top of which away goes the wheel into a hole, corresponding in depth with the height of the hillock, and altogether forming a section sufficient, without great care on the part of the driver, to overturn the carriage. Now, how can such a road as this be dealt with but by going to the root of the evil? To apply more materials when there are too many already would be absurd; yet such would be the practice of the old school. Cart-loads of the same huge materials would be brought and shot down, as little prepared as the road itself is to receive them. What must ensue from such a course of proceeding but a continuation of the same form of road; to be travelled over in the same rough, dangerous, and miserable condition? A great expense, however, will have been incurred in carting these huge masses to the road, but no improvement effected. Surely it must appear evident that the simple mode of proceeding would be, to provide those poor industrious people, who would cheerfully work if they could find employ-

ment, with pick-axes, shovels, hammers, and rakes. Then to direct them to strike well into the root of the evil, to pick up this misshapen piece of work to such a depth, that the section of the road may be made true; that all the stones that may be found there may be taken out and broken, and when so broken again returned to it. In many instances more materials will be found than the road requires; and again, in some instances, there may not be substance enough. Under such a state of things, it is obvious what course should be pursued, so as to render the purchase of additional materials unnecessary.

Here, then, we find nothing but *manual labour* required, effectually directed by the practised surveyor; and it may fairly be deduced that, instead of incurring a large expense in cartage, without producing any improvement, a good road will be made without much, if any, additional cost. This may be asserted, because the power which has been employed in it would have remained unproductive and supported in its idleness by the same parties who have the charge upon them of repairing the highways. However, even setting that consideration aside, and looking only to the absolute cost of the two systems in this one single case of repair, it will appear that the new practice is decidedly the cheapest; for example, the old school, with a view of repairing this unfortunate-looking road, would bring two cubic yards of materials at the least to the rod superficial, which at a moderate computation would cost 3*s*., but more probably 5*s*. per yard, which would be 6*s*. per rod. The lifting in the case similar to that described would be done for 1*s*. per rod superficial, and the breaking the flints which would come out would cost 1*s*. per cubic yard. Now, even if two cubic yards per rod should be taken out of the road so lifted, the expense would not amount to more than half of the cost of the old practice. To say nothing, then, of the saving in a course of years by the durability of a road formed under the new system, and which has been found in some cases even where the traffic is considerable, by the side of a large town, to last for seven years without an additional stone being applied; to say nothing of the saving to the public in wear and tear of horses, carts, and tackle; to say nothing of the comfort of travelling a smooth road; and also to say nothing of employment being, by the new system, found for the poor: yet a road can be maintained good and perfect for half the sum under the new system, which, under the old, is expended without improvement.

The mode of lifting just described applies to roads in the worst condition as to the sections and former preparation of the materials. There are other cases which call for the operation of lifting. The next is, when the road is partially out of form, having at the same time in its substance materials the nature of which is not large, but consisting of inferior pebbly stuff. Here we must not go to the extent and depth, as in the last case, but just pick it up sufficiently to produce a good section. Here, too, perhaps, there is not weight of metal enough to sustain the burthens the road is liable to. If so, after the lifting is performed, and before the surface becomes settled, a coat must be applied; and attention must be paid to the surface, by scratching it with the tooth-rake regularly all over, as occasion requires.

Lifting again must be resorted to when granite or other material of the hardest kind is used, and which has been for some time the usual substance provided for the road. It is more particularly necessary to loosen the surface which contains granite, because the additional supply cannot so readily become incorporated when the road is already hard. The two substances being of similar hardness, oppose each other for the possession of the surface; the one, however, which is already fixed has the advantage over the one newly brought on, and the consequence is that it becomes partially worn

away by the action of the wheels before it is forced into the society of the rest. If granite were proposed to be laid on a gravelled road, there would not be *so much* necessity for lifting, because the weaker must give way to the stronger substance; at the same time it would be advisable in this case to loosen the surface to admit granite. In the operation, however, it would not be necessary to do more than just to bury the point of the pick-axe to the depth of an inch and a half, to produce, as it were, a soft bed for the granite to repose upon, bearing in mind a former injunction, not to lay on more than a cubic yard to a rod superficial. The object to be gained by lifting, when additional materials are applied, is, that they may become incorporated immediately before any injury has been done to them by the wheels. When the surface is open, each stone takes its place as soon as laid on, and is enabled to retain its place by the assistance which the angles afford it. On the contrary, if the road be hard and not opened, a great portion of the material is destroyed and rendered useless before incorporation, and the grit arising from the pulverization causes the draught to be heavy. In all cases, then, but when the road is extremely wet and soft, it will be advisable to open the surface to receive metal.

On hilly parts of the road in particular, lifting should be resorted to at all times. If stones be laid on in these places they cannot be expected to unite with the road in the same position as they were intended to do if not lifted. They will, of course, work longitudinally down the hill, and also roll on either side into the watertables. The necessity for having the cross sections sharper down a declivity, in order to draw away the water quickly, causes the material to roll more rapidly off the road.

### TRANSVERSE SECTIONS.

If a man be not sensible of the necessity of true cross sections in road-making, he is not qualified for a surveyor. How can the surface-water escape, if the sides of a road be higher than the centre? It must remain soaking into the materials, rendering them soft and powerless, and causing rapid decay to all the substances within its influence. This, one would imagine, must be known to all, and yet how little attention is paid to this part of the subject. Even on roads having great traffic, and to which one would expect particular attention to be paid, the grossest errors in this respect are committed.

A road should fall transversely from the centre to the watertables at the rate of 1 in 24 along flats or level ground, and sharper in proportion as declivity increases. It is made rounder, or the section is sharper down a hill, that the water may be the more quickly carried off to the sides into the watertables, for, if not quickly carried there, it will run longitudinally down the road, to its great injury. Let it be borne in mind that the boldest surgeon makes the best cure. If, therefore, the road be defective in its transverse sections, showing the watertables higher than the centre, be not afraid to cut deep, always remembering that the true form must be produced, and that if you stop short but one inch in the operation, no good will have been effected. It is well known that in cauterizing a wound, if but a small particle of gangrene remains, the cure is not accomplished, and mischief ensues; so in road-making, if the watertable be in the slightest degree higher than it should be, the water cannot be drained into it. Fear not, then, but cut on; and if, in obtaining the proper fall, you are driven into the substratum, and have no hard substance left, take out the substratum still deeper, and fill up with sound materials. It is necessary, and perhaps more necessary, to have as great a degree of substance at the sides as at the centre of the road, particularly where the traffic is great. In passing each other, carriages must travel on the sides; and if there be a formed footway,

't will be found that carters use it, keeping their teams on the sides of the road just within reach of the whip. Be careful, however, not to make the section sharper than in the above proportions, if the ground lie tolerably level, for if a road possess too much of convexity, the chance is destroyed of keeping the materials fixed and well embodied. The bearing of the wheel is then not perpendicular, and has a tendency to displace the metal, particularly if of a circular form, and the draught becomes heavier for the horses. When the repair of a road is well conducted, the body of it will be sound and the surface smooth; and when so, a very slight convexity will serve to carry off the water, which is the only motive for keeping any convexity at all.

Again, when a road is very round, the carriages are naturally enough conducted along the crown of it, causing it to be worn much in that part, and but little in the other parts, and thereby producing ruts. The foundation, therefore, should possess the same section as the surface, and an uniform thickness of materials be found upon it. When this is the case, the road will be more likely to be kept dry, than when it is made flat, and the surface section obtained, by having a thicker substance of metal at the centre than at the sides.

### ONE-SIDED ROADS.

All principle is against the form of one-sided roads, yet they are to be seen in every direction. In order to keep a good road it is necessary to draw off the water as soon as possible, that the materials may not be sacrificed, and that the draught may be light. Will a one-sided road effect this? —No. The water has to pass over twice the surface of road before it reaches the watertables; and the result is, that the lower part of the one-sided road becomes doubly saturated with water, and the wear unequal. This calls for an additional coat in that part of the road, and causes a system of repair which militates against the chance of having a true surface. If first one side of a road be coated and then the other, it is very difficult to obtain equal wear over the whole. An endeavour should be made to cover all the surface at once, and so slightly, that the public may not fear to travel over all parts alike. But this will not take place on one-sided roads, for the reason just given.

Then, to cause as little wear as possible, the pressure upon the surface should be perpendicular. On a one-sided road a carriage cannot stand upright, for the weight bears more upon one wheel than another, and not only more upon one wheel than another, but upon one edge of that wheel. It has a constant tendency to slide towards the lower side of the road, and by that motion displace the materials. The shifting of the materials renders the road heavier to travel upon, and a compound motion being produced by the tendency of the wheel so to work down to the watertables, the draught is made still heavier for the horses. There are very few cases which will justify the practice of having one-sided roads, for the reasons above stated.

### SPREADING.

Having gone through all the preliminaries necessary to be described before the coat is laid on, we must now describe the manner in which this should be done.

To the generality of persons it will seem that, to say anything upon this point must be superfluous, but it is not so. Much more depends upon this operation than a casual observer would suppose. In fact, it would be impossible to obtain a true section if this part of the art be neglected. The

general mode of doing it is, to have the load shot down upon the spot which is supposed to require additional materials; a portion of it is then pushed to the right and left, and the main body left upon that part of the road where it was first placed. The consequence is, that the part of the surface containing the greatest portion of materials will, when those materials are embodied, present a section of great inequality. The carriage will then have an undulating motion, very distressing to the parties travelling by it.

The proper mode of spreading is this: To cause the load to be shot down a short distance from the place upon which you wish the materials finally to be spread; and to direct the spreader to cast every shovelfull from him equally all over the surface, and in such a manner as he would do if he were sowing wheat broad-cast. The road will then be not thicker in one place than another, and a section will be produced, perfect and true.

### THE RAKE.

The rake is a very useful implement, but at the same time, if the practice herein described, of laying on coats of only a stone's thickness at a time, be adopted, it will not be so much called for as in the old practice of thick coating. However, it should always be at hand to level any irregularities which may occur whilst the materials are going down. If any ruts appear this tool must be used to keep a regular even surface, but caution must be observed in its application. The labourer, if left to himself, when a rut shows itself, will gather all the loose stones he can find, and draw them into the rut, with the view of levelling it; but this does mischief, and should not be allowed, because by doing so he causes the road to be harder in those places than the rest of the road. In the summer, it will present an uneven surface, showing longitudinal ridges where the ruts were, and be the means of forming a barrier to the escape of the water. In using the rake, then, let him work it backwards and forwards on each side of the rut, and across it, and if he do it with his eyes shut, he will do more good than by taking pains to gather all the stones he can find to place in it.

### SCRAPING.

If it be desirable to keep a road dry at the foundation, it must be equally so at the surface. By drawing the water quickly from the surface, the drainage at the foundation is comparatively of less consequence, because it has not time to soak through to the bottom. If mud be allowed to remain on the road the water is impeded in its course towards the watertable, and by dwelling on the surface finds its way to the subsoil. Great mischief arises to the materials, and they are rendered soft and powerless, causing the draught to be very heavy, and the road unpleasant to be travelled upon. The moment, then, that mud appears let it be scraped off and removed immediately from the road.

### SUN AND WIND.

If a road be inclosed by trees or high hedges, it will be impracticable to keep it good, and at the least expense. The additional charges are great when so situated. Every attention should be paid therefore to enforce the law, so as to have the hedges kept low and the trees trimmed. Too great indulgence is by the present act given with respect to trees, as a surveyor cannot compel parties to trim them up in all cases, for if situate in a garden, yard, park, or paddock, or if they may be deemed ornamental, or a shelter, he cannot touch them. In general, it is considered that private

interests should yield to public good, but in this instance the rule is departed from, to the great inconvenience and annoyance of the traveller.

### EVIL EFFECT OF BADLY-FORMED ROADS.

If the generality of persons knew how much more they are called upon to pay for the support of roads which they are daily travelling over than is necessary for their repair, more anxiety would be shown to have the system altered; but the fact is, their attention is not directed to the subject. So long as they can pass and repass with any tolerable degree of security they murmur not. Nothing is said one way or the other. If they cannot do this, and great inconvenience occurs, then a little stir is made to remedy it, and as soon as they can pass again as usual they are quiet. The expense is not looked to in either case whether the passage be good or bad. True it is, however, that the better the state of passage, the less the charges for such passage.

When the section is true, the surface smooth and dry, with no irregularities, the less the wear and tear. If large stones are laid on, intermixed with smaller ones, after a little while the large stones appear above the general surface, causing it to be rough and uneven. The wear and tear then becomes progressively greater. The wheel drops from the top of the protruding stones, making a hole on each side of it. In these holes the water dwells, decomposing the materials at a rapid rate, and faster and more fast the road decays; so if the coats be imperfectly spread, the section becomes defective, with every here and there a pool of water appearing. This again ruins the power of the metal, and the surface being irregular, great friction ensues, and wear takes place rapidly. Not so when the repair is properly conducted. The carriage-wheel, having no obstacle presented to it, passes evenly and uniformly along; it does not press more in one place than in another, and the materials are not displaced. The substance of the road is not decomposed by water lodging, but remains sound and hard, capable of resisting the pressure above. A great failing in many roads also is, that sufficient power is not given to them; they are always below the mark. When this is the case, a true section cannot be preserved; the want of power causes it to yield to the pressure. The materials are worked backwards and forwards by the passing wheels, and when in this state the wear is enormous. It is similar to patching up on old waggon-wheel, which being unequal to the weight it has to carry, is continually breaking down, incurring fresh expense to repair it. When a road is once well up to the mark, in good form, and in every respect attended to, the wear is trifling in comparison with an ill-managed and a neglected road, proving that economy is best consulted by an early attention to the first symptoms of decay.

There is no doubt, *because it has been proved by practice*, that where a road is managed upon the principles here laid down, it can be kept in high condition for fifty per cent. of the cost under the old system of repair. Taking the parish roads throughout the kingdom, it may with safety be asserted that they may be kept in repair, in as good repair as the turnpike roads, at a great deal less expense than is at present laid out upon them. The poor would be employed, and the poor-rate reduced; a great saving in the wear and tear of horses, carts, and tackle would be effected; heavier loads moved with less strength; time saved; and the ease and comfort of the public greatly increased.

### EFFECT UPON A ROAD OF DIFFERENT WIDTHS OF WHEEL.

The amount of injury done to a road by weights passing over it, and

the rate at which that injury is modified by the width of the wheels, is a matter very difficult to ascertain. It depends much upon the materials of which the road is made, the state of the weather, the form of the road, the part of the road over which the weight goes, and perhaps the speed of the carriage. Thus experiments are difficult to make. This, however, may be safely affirmed, that on the one hand scarcely any toll will compensate for the injury done by a great weight conveyed on narrow wheels; and on the other hand, a weight may be so excessive as to be injurious upon any width of wheel which it is reasonable to suppose may be used.

Injurious action upon the surface of the road, diminishes progressively as the width of the felloe of the wheel increases, provided the weight be not excessive. A wheel may so increase in width as to act as a roller or compresser; and, within certain limits, the heavier the roller, the more effectual it is in producing the desired effect, viz., compression. Thus, although a wheel shall carry weight for inches, it may approach, as the width of the felloe increases, to the point at which, instead of causing injury, it will benefit a road.

Then, as to the mode of levying Toll in order to be reimbursed for the injury done by each wheel.

The Lords' Report in 1833, upon the subject of the weight to be carried, is this:

"The supposed benefits to be derived from limiting the weights to be conveyed on roads have been so much defeated by the practice of compounding for overweights, that they recommend the abolition of the use of weighing engines."

Perhaps the best practical check upon the amount of weight to be carried, consists in putting the toll upon the strength employed; *i. e.*, the number of horses drawing; for no person who knows his own interest will use less strength than is fairly necessary, unless the high amount of toll be a prohibition.

So far as observation is capable of ascertaining results, the injury done to a road appears to the Author to be one-fourth in amount as the width of wheel doubles, supposing each sort of wheel to carry the same weight.

| | | | | |
|---|---|---|---|---|
| Supposing a | 3-inch | wheel to pay | . . | 6*d.* per horse. |
| | 4½ | ditto „ | . . | 4½*d.* |
| | 6 | ditto „ | . . | 3*d.* |
| | 9 | ditto „ | . . | 1½*d.* |

The amount of weight to be carried may, with little risk, be left open; for the high rate of toll will be a check upon heavy weights being conveyed upon the narrow wheel in a bad state of road: which will only be practised when the roads run light, and when the weight can be moved with less strength, and less injury. For the worse the state of the road, the smaller will be the relative degree of draught upon the broad wheel; and thus in proportion to the good or bad state of road, should a narrow or broad wheel be used.

If the road be weak, spongy, and loose, the draught will be lighter upon the broad wheel; and *vice versâ*, if the road be sound and good, the draught will be easier upon the narrow tire. The use of the different widths of wheel will vary as the state of the road varies, from the fallow field to the iron railway. Not so the wear; that remains relatively the same, be the road good or bad: for a narrow wheel will wear out an iron rail in the same relative proportion as a turnpike road, and in all states of a road will carry with it the same relative degree of injury. Perhaps immediately upon the breaking up of a frost, the broad wheel will lick up and carry the crust

of a road from one place to another, and cause it to be out of shape until re-formed again; but then in such a state of road the narrow wheel will cut through to the foundation, and create mischief in that respect. But conceding that, under such circumstances the broad does do more injury than the narrow wheel, it is but for a very short period of the year, perhaps only for a day or two, and bears no comparison at all with the great degree of injury a narrow wheel occasions all the rest of the year. If it were nicely observed, a narrow wheel, although the road shall be in a hard state, will be found to have caused much greater pulverization after passing along a road than the other wheel; and it is only because the road, when in a hard state, does not show the wear so conspicuously, that it is thought by some persons to do no more harm than the broad wheel.

It may be a matter of consideration, whether the narrow wheel shall not be allowed greater latitude or indulgence, when the roads are brought to greater perfection than at present, seeing that the draught upon them is lighter relatively with the broad, as the condition of the road improves, and more advantageous for the public to use. In the present state of most of the roads in the kingdom, it would be ruinous to the Trusts to encourage the use of narrow wheels by an abatement of toll. If indulgence be given to the narrow wheel, it will be the means of reducing roads to a generally bad state of repair; when so reduced recourse must be again had to the broad wheel, so that by such a policy, the only result would be, that a temporary indulgence will have been given to the narrow wheel, at the expense of a reduced state of repair, loss of income, and to the annoyance of the public.

### SHAPE OF WHEEL.

Having endeavoured to describe and settle the degree of injury which is done to a road by wheels of different dimensions, it is now necessary to say a word or two upon the effect which wheels of different *shape* have upon the wear of a road, and the draught they occasion.

It is obviously true, that the wheel of a cylindrical form has the advantage of the wheel of a conical form, both as far as regards the wear of the road, and the draught for the horses. The cylindrical wheel stands upright, having a perpendicular pressure on the road, and the felloe being parallel with itself, the periphery is the same inside as outside; whereas the conical wheel is made of a dishing shape, the bearing or direction of the felloe, instead of being parallel with itself, inclines to a point forming a cone, the base of which is the inner periphery of the wheel, and the apex a point ascertained by producing the lines of felloe, formed by the inner and outer periphery.

The conical wheel, then, from its peculiar construction, having the inside greater than the outside circumference, and being obliged to go forward in a right line, causes a compound motion, which in its progress produces a screwing or grinding effect upon the materials, and in a measure displaces them. This injures the road, and makes the draught heavier.

On the other hand, in favour of the conical wheel, there is more room given for the body of the carriage; and also by its standing out from the body, the cart itself, in crowded streets, is protected, in case of collision with another cart, the projecting part of the wheels alone coming in contact, and gently rubbing one another off. As far, however, as regards the wear of the road, the upright or cylindrical wheel ought to be encouraged.

Then with regard to the shape of the felloe. It will be seen that the general practice has been to make a six-inch felloe, in a great degree circular, instead of flat, which, of course, has had the effect of injuring the roads, and of deluding the trustees of the turnpikes. Much of the dislike

which has been felt by some surveyors to the broad-wheel, has arisen from this cause, and with reason. The six-inch wheel is allowed to carry greater weights than the narrow wheel, and pays at the same time less toll. The circular form of the felloe prevents the whole six inches from bearing upon the road, and, in many instances, will be found to roll no greater surface than the three-inch wheel.

If, then, it is allowed to carry more weight, and pay less toll, the objection of the surveyor is very natural. It probably, under these circumstances, has double the advantage of the narrow wheel, or is of double injury to the trust. Provision ought therefore to be made, that the whole professed width of felloe be made *flat*, so that it bear upon an equal superficies of road. If so provided for, the injury done by each sort of wheel will be found to be equal to the amount described in the scale herein given.

### EFFECT OF WATERING ROADS.

The introduction of the water-cart, both as far as regards the comfort of the traveller and the preservation of the road, may be considered one of the greatest improvements recently adopted. The advantage to the traveller is of course obvious, as far as his own comfort is concerned; but if the watering be carried to too great an extent, he does not derive any benefit with respect to draught. If the road be saturated with water, so as to create mud, a state of surface is produced, little less heavy for the horses than winter itself causes. When the operation is judiciously performed, the materials are preserved from that degree of pulverization which, in a dry summer, invariably takes place. On a road, repaired *with flints* or *gravel*, or *any other brittle material*, the wear from drought is very great. As dry weather continues, the materials become loosened, and the surface presents an appearance of a coat newly laid on. The action of the wheels produces a great degree of pulverization, and the wind carries off the materials so reduced to a powder.

If there be no wind for any length of time, an accumulation of dust takes place, which is obliged to be scraped off; and thus the road becomes impoverished, losing rapidly the substance necessary to support weights; and rendering necessary additional coats, so soon as the weather will allow them to be put on.

Now a well-directed supply of water, equally distributed over the surface, tends to prevent this effect. It keeps the crust of the road settled, it supports the materials in their places, preserving the cement necessary for this purpose. When, however, the distribution of the water is too heavy, or irregular, mischief is done to the road, and wear will be caused in as great a proportion by over watering, as by not watering at all. Decomposition of the substances contained in the road ensues, in proportion to the over supply of water necessary merely to settle the surface. There is a point, therefore, at which the quantity required to effect good may be exceeded, and it requires some judgment, and a good deal of attention, to direct the use of the water-cart.

Again, if the carts be not scientifically constructed, the water will be distributed in streams, throwing a greater quantity in one place than in another; and when that is the case the wear of the road will be unequal. A road also may be watered too slightly: when it is so, the crust, or rather the loose dust, will appear adhering to the wheel, causing a heavier draught than if not watered at all, and injuring the road.

So great is the benefit of judicious watering to a road composed of materials which in themselves *are brittle*, that it may be considered advisable to

use the water-cart for the sake of the road itself, setting aside any consideration which the public may be entitled to.

### CARTAGE.

It has before been said, that the object of this little essay is intended to bear chiefly upon the system of managing *parish roads*. This head of the work applies particularly to the mode by which the carting is done under the present highway laws. In this item of expenses lies one of the greatest grievances, seeing that it forms a main part of the expenditure in the repair of parish roads, and by its evil tendency causes a ruinous state of repair. The system of statute-duty naturally induces a larger outlay to take place in horse labour, than would otherwise occur, even under the present mode of appointing surveyors. If the parish surveyor collected all his revenue in money, and had to pay hard cash for the horse-work done, he would not lay out so much in that description of labour as he now does.

At present the nominal amount is very great, without a corresponding benefit being received. In many cases, indeed, the effect is greatly injurious, causing additional materials to be heaped upon the road, when there is already an abundance. It substitutes an imperfect, not to say injurious mode of repairing roads, for a perfect and beneficial one.

It is one part of the proposition set forth in the beginning of this work, to do away the statute-duty, which is not only complicated in its mode of being ascertained and called out, but which has been shown to bear unequally and unfairly upon the rate-payers. If done away, the horse-work necessary to be performed, in bringing such materials as may be required, may be executed by those persons who are to be assessed for the horses they keep, in fair proportions, and be paid for the same by the scale before alluded to.

For example: At the beginning of a new year of repair, it will be ascertained by the surveyor, as near as may be, how many cubic yards of gravel, &c., he will require for the supply of his roads during the current year, and what distance they will have to be carted. He will know, by his rate, how many horses each person will be charged with. Then apportioning the number of yards of materials to the number of horses kept, he will give the option to each party, to cart such a number such a distance. According to that distance he will be paid the sum described in the table or scale; and thus every one will receive a fair remuneration for the work done. This head of expenditure will by this means be fairly and equally regulated.

The horse-work is very differently conducted in the shape of statute-duty, and a great loss in horse-power is consumed in idleness. To give an idea of the difference in the amount of work which is done as statute-duty, and when done as piece-work, or paid by the table, the following case, amongst many others which might be enumerated, is here related, and which actually took place.

Two parties were set to work to cart materials from the same pit to the same place. The one understood that he would be paid for the work he did according to the table, at so much per furlong per cubic yard, the other thought he was working out his statute-duty. The one sent two horses and man and cart, and carried a yard and a half of materials at a time, and in the course of the day carted 16½ yards, which, at 7½*d.* per yard, the price allowed by the scale, came to 10*s.* 3¾*d.* The other sent three horses, man and boy, and carted 10½ yards, for which, as statute-duty, he was entitled to 15*s.*, being the price of a team, as fixed upon by the magistrates. The cost to the parish, therefore, by statute-duty, was 17*d.* instead of 7½*d.* per yard.

The table here alluded to is founded upon the following principles :—

That three horses, a man and boy, with proper carts, &c., should earn 15*s.* per day, when oats sell at 20*s.* per quarter.

That as a horse is to earn 5*s.* per day, it must be calculated what he ought to be paid to enable him to do so, and what quantity of work should be done for the money.

That a team should travel ten miles out and in for a day's work. That this should be done in eight hours, which is at the rate of a mile in forty-eight minutes, or a furlong in six minutes. That six minutes be allowed for shooting the load, and for shifting the horses from one cart to another each turn. That having thus the length of the day given, and the rate of travelling, with the allowance of time for shooting and shifting, the number of cubic yards which should be carted in a day is easily ascertained.

Thus the length from the pit to the place of shooting the materials upon the road, shall be taken as four furlongs, which, according to the given rate of travelling, will occupy twenty-four minutes, and the shooting six minutes, equal to thirty minutes.

Therefore, 480 minutes, or eight hours, the length of the day, divided by 30, will give 16, the number of turns a team should go in a day, the distance being half a mile from the pit to the place of shooting.

Then two horses with a cart should carry a cubic yard and a half of materials at a time, which will give 24 yards in the day. Now two horses are to earn ten shillings, as shown, which, divided by 24, the number of yards to be carted for that money, gives 5*d.* per yard, the proper price to be given for carting a cubic yard of materials the before-mentioned distance, when oats are at 20*s.* per quarter.

## A CALCULATION, OR TABLE

*For regulating the Prices to be given per Cubic Yard for Carting on the Highways of England.*

| Distance in Miles and Furlongs. | | Number of times a Team should go in a Day. | Number of Cube Yards with Two Horses. | Price when Oats sell at 20s. per quarter. | Price when at 25s. | Price when at 30s. | Price when at 35s. |
|---|---|---|---|---|---|---|---|
| | | | | Equal to per day 10s. | Per Day 11s. | Per Day 12s. | Per Day 12s. |
| m. | f. | | | d. dec. | d. dec. | d. dec. | d. dec. |
| 0 | 1 | 40. | 60. | 2.0 | 2.2 | 2.4 | 2.6 |
| 0 | 2 | 26.666 | 39.999 | 3.0 | 3.3 | 3.6 | 3.9 |
| 0 | 3 | 20.000 | 30.000 | 4.0 | 4.4 | 4.8 | 5.2 |
| 0 | 4 | 16.000 | 24.000 | 5.0 | 5.5 | 6.0 | 6.5 |
| 0 | 5 | 13.333 | 19.999 | 6.0 | 6.6 | 7.2 | 7.8 |
| 0 | 6 | 11.428 | 17.142 | 7.0 | 7.7 | 8.4 | 9.1 |
| 0 | 7 | 10.000 | 15.000 | 8.0 | 8.8 | 9.6 | 10.4 |
| 1 | 0 | 8.888 | 13.332 | 9.0 | 9.9 | 10.8 | 11.7 |
| 1 | 1 | 8.000 | 12.000 | 10.0 | 11.0 | 12.0 | 13.0 |
| 1 | 2 | 7.272 | 10.908 | 11.0 | 12.1 | 13.2 | 14.3 |
| 1 | 3 | 6.666 | 9.999 | 12.0 | 13.2 | 14.4 | 15.6 |
| 1 | 4 | 6.154 | 9.231 | 13.0 | 14.3 | 15.6 | 16.9 |
| 1 | 5 | 5.714 | 8.671 | 14.0 | 15.4 | 16.8 | 18.2 |
| 1 | 6 | 5.333 | 7.999 | 15.0 | 16.5 | 18.0 | 19.5 |
| 1 | 7 | 5.000 | 7.509 | 16.0 | 17.6 | 19.2 | 20.8 |
| 2 | 0 | 4.705 | 7.059 | 17.0 | 18.7 | 20.4 | 22.1 |
| 2 | 1 | 4.444 | 6.666 | 18.0 | 19.8 | 21.6 | 23.4 |
| 2 | 2 | 4.210 | 6.315 | 19.0 | 20.9 | 22.8 | 24.7 |
| 2 | 3 | 4.000 | 6.000 | 20.0 | 22.0 | 24.0 | 26.0 |
| 2 | 4 | 3.809 | 5.713 | 21.0 | 23.1 | 25.2 | 27.3 |
| 2 | 5 | 3.636 | 5.454 | 22.0 | 24.2 | 26.4 | 28.6 |
| 2 | 6 | 3.478 | 5.217 | 23.0 | 25.3 | 27.6 | 29.9 |
| 2 | 7 | 3.333 | 4.999 | 24.0 | 26.4 | 28.8 | 31.2 |
| 3 | 0 | 3.200 | 4.800 | 25.0 | 27.5 | 30.0 | 32.5 |
| 3 | 1 | 3.076 | 4.614 | 26.0 | 28.6 | 31.2 | 33.8 |
| 3 | 2 | 2.962 | 4.443 | 27.0 | 29.7 | 32.4 | 35.1 |
| 3 | 3 | 2.857 | 4.285 | 28.0 | 30.8 | 33.6 | 36.4 |
| 3 | 4 | 2.759 | 4.138 | 29.0 | 31.9 | 34.8 | 37.7 |
| 3 | 5 | 2.666 | 3.999 | 30.0 | 33.0 | 36.0 | 39.0 |
| 3 | 6 | 2.580 | 3.870 | 31.0 | 34.1 | 37.2 | 40.3 |
| 3 | 7 | 2.500 | 3.750 | 32.0 | 35.2 | 38.4 | 41.6 |
| 4 | 0 | 2.424 | 3.636 | 33.0 | 36.3 | 39.6 | 42.9 |
| 4 | 1 | 2.353 | 3.530 | 34.0 | 37.4 | 40.8 | 44.2 |
| 4 | 2 | 2.286 | 3.429 | 35.0 | 38.5 | 42.0 | 45.5 |
| 4 | 3 | 2.222 | 3.333 | 36.0 | 39.6 | 43.2 | 46.8 |
| 4 | 4 | 2.162 | 3.243 | 37.0 | 40.7 | 44.4 | 48.1 |

# HINTS

FOR THE

# PRACTICAL ADMINISTRATION

OF THE

# POOR LAWS.

*UNDER THE SUPERINTENDENCE OF THE SOCIETY FOR THE DIFFUSION OF USEFUL KNOWLEDGE.*

LONDON:
BALDWIN AND CRADOCK, PATERNOSTER-ROW.

MDCCCXXXII.

LONDON:
Printed by WILLIAM CLOWES,
Stamford Street.

# HINTS

FOR

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One of the heaviest burthens borne by agriculturists is the Poor Rate: any practical mode of lessening the amount of this impost will not be unworthy our attention, especially if, at the same time, such diminution can be shown to be beneficial rather than injurious to the working classes.

The administration of the poor laws is confessedly very different in different parts of England, and as the effects of the difference are plainly perceived both in the amount of the rates and the depression of the workmen, it may be worth while to consider what is the best plan to adopt.

In one county, we shall find, the poor rates amount to 1*l.* per head on the whole population, as in Sussex; in another, it will only be 4*s.* per head, as in Lancashire; and while the local expenditure (of which far the largest portion is for the maintenance of the poor) is in some counties, as Sussex or Bedford, above 6*s.* in the pound on what is probably the full annual value,—in other counties, as in Northumberland, Cumberland, the North Riding of Yorkshire, and Shropshire, it varies from 1*s.* 7½*d.* to 2*s.* 5*d.* in the pound*.

That these differences in the amount of rates arise chiefly from the difference of management, we have the testimony of numerous able writers, and of several Reports of Parliamentary Committees, resting upon evi-

* Accounts of Local Taxation, ordered by the House of Commons to be printed, Dec. 6, 1830, paper 52. The information given is very important, and the deductions curious.

We have made, from the returns to Parliament, a calculation as to the proportion of the cost of the poor, comparing the average of the three years 1812, 13, and 14, with the three years 1827, 28, and 29. The average expenditure of the three former years was about 6,400,000*l.*, with corn at 102*s.* per quarter; of the three latter years, 6,300,000*l.*, with corn at 57*s.* per quarter. We have calculated that two-thirds of the expenditure on the poor varies with the price of corn. Then to maintain the same number of poor with the same proportioned allowances in the latter period, the cost ought to have stood—

| | |
|---|---|
| One-third part of cost, stationary . . . . . | £2,100,000 |
| Two-thirds at rate of corn three last years, 46 per cent. reduced | 2,200,000 |
| | £4,300,000 |

but the actual cost is 6,300,000*l.*, that is, an excess of what it ought to be of nearly one half of what the whole should amount to. Making an allowance for the increase in population of 24 per cent. in the fifteen years, yet bearing in mind this has chiefly been in manufacturing counties, where the rates are not augmented in proportion, we shall come to a conclusion that there is an increase in the proportion of expenditure on the poor, and probably of the numbers of poor, of above one-fourth in fifteen years. The above calculation, if not quite exact, will show the main points deserving of attention.

dence. Abuses of various kinds have been introduced, in many of the southern counties especially, productive of serious injury to the landowner and the peasantry.

The execution of the poor laws being generally left to the farmers of the parish, we shall endeavour, as briefly and clearly as possible, to point out how this important duty should be executed.

It seems evident that the execution of these laws, like every work undertaken by man, will be better executed by those who have experience in the matter, and who constantly attend to it, than by those who are unwillingly obliged to leave for a short time their usual occupations, to betake themselves to this rather unpleasant task. Hence it will be seen that it is not very likely that the old mode, still adhered to in many parishes, will succeed, of appointing annually two inhabitants as overseers, upon whom is to devolve for a twelvemonth the administration of the poor laws within the district. Unacquainted previously for the most part with the complex laws they have to administer, and having little personal knowledge of the applicants, they will content themselves generally with getting through the necessary business with as little trouble as possible, and will follow pretty nearly the practice of their predecessors, whatever it may be, especially if sanctioned by the neighbouring justices*. A twelvemonth having elapsed, (too short a period for the former overseers to become acquainted with their duty,) fresh ones are appointed, who have everything to learn! Such a system is almost sure to cause or perpetuate abuses.

If a parish be sincerely desirous to lessen their expenses and duly administer the law, their first step should be to appoint a permanent overseer, paid by the parish, answerable to the vestry, and removable for misconduct. It will be the business of this person to acquaint himself with the law, and his duty to execute it; he must devote himself to this object, and will soon become acquainted with the characters of applicants and the best mode of dealing with them.

There is no difficulty whatever in the appointment of such an officer. The rated inhabitants have only to meet together in vestry, and agree to employ such a paid overseer, and his appointment will be confirmed by the justices, as provided by the 59 Geo. III. c. 12†.

* 'Named only for one year, and in general anxious chiefly to get rid of his office with as little trouble to himself as possible;' or if 'he endeavours, in spite of clamour and vexation, to improve the practice, his designs are liable to be overset by the orders of magistrates.'—*Report on Labourers' Wages*, p. 6, 1824.

† It would be of the greatest advantage that some alteration should take place in the law, so as to allow to the *owner* of rated property, or his agent, considerable power in laying on the poor rate, and administering it when raised; in which case, the owner should contribute a certain proportion of the rate: at present it is under the sole control of the occupier, who pays the whole. The tenant-occupier, however, has not the same permanent interest in the proper management of the rate as the owner has: if the rates increase, the tenant on each fresh letting will make this a ground for a diminished rent, and often thinks it is for *his* interest to keep wages as low as possible, however high the rates may thereby be raised; and this accounts for some of the abuses of the poor law prevalent in several counties of the south of England. If the owner paid a proportion of the rate, its increase would be a salutary warning to him that some attention to the subject was necessary, and his interest would direct him to improve the condition of the workmen, as the only true and permanent mode of keeping the rates low. In ordinary cases and in agricultural districts, it is a general rule that rates and wages vary inversely to each other: if wages are high, rates are low; and if rates are high, wages are low. In Scotland, the rate is laid on by the heritors only, or their agents, in conjunction with the clergyman, and paid in equal portions by heritor and occupier, and expended by the minister and kirk session.

In above two thousand parishes such permanent overseers are now employed, and are, almost without exception, found highly useful: the amount of their remuneration is generally saved over and over to the parish by the diminution of other expenses.

If the parish in question be so small as not to require the constant attention of the permanent overseer, he may combine the business with the care of some adjacent parish or parishes similarly situated, or with any other occupation. The duties, however, to be performed, if duly executed, are so numerous, that in most parishes his time will be pretty much engaged, as will be seen when we come to consider how he ought to act.

We have stated that, in a parish containing small numbers, a permanent overseer, acting under the control of the annual overseers, may be sufficient; but in every populous parish there should also be a select or elected vestry, chosen under that useful Act of Parliament 59 Geo. III. c. 12, commonly called Mr. Sturges Bourne's Act, and consisting of any number, from five to twenty *.

These persons being chosen by the rate-payers, the latter are, of course, interested to choose such respectable and intelligent inhabitants as are likely to attend to a subject alike important to themselves, their neighbours, and the humbler classes. The services of these vestrymen are unpaid and voluntary; but as they may be re-elected or removed by the rate-payers at certain periods, it is not likely that others than those willing to do their best will consent to act.

The paid overseer is completely under the control of such a select vestry: it will be their duty to investigate and manage the parish expenditure; and they ought annually to publish a balance-sheet, for the satisfaction of the parishioners, drawn up in the same form for the convenience of comparing one year's outgoings with another's, and divided into separate heads of expense, in as simple and short a manner as possible, so as to be plain to the capacity of every rate-payer †.

Having thus a permanent overseer and (in a large parish) a select vestry, it is necessary, in order to carry the law into effect, that there should be, within or near the parish, an efficient workhouse and poorhouse. These may be either together or separate; but they are better separate, for reasons we shall soon state. In general they are united, and in many parishes, though there be a nominal workhouse, it really is nothing but a poorhouse.

Those to whom assistance is to be afforded from the poor rate, are described in the words of the important statute, 43 Eliz., c. 2, §. 1, as follows:—

'The churchwardens and overseers, with the consent of two justices, shall take order, from time to time, for setting to work the children of all such whose parents shall not, by the said churchwardens and overseers, or the greater part of them, be thought able to keep and maintain their children, and for *setting to work* all such persons, married or unmarried, having no means to maintain them, and using no ordinary and daily trade of life to get their living by; and for the necessary relief of the lame, im-

* 'The greatest evils arise from entrusting a business so complicated to inexperienced and inefficient officers; and much benefit has been produced by taking advantage of the provisions of 59 Geo. III. c. 12, on this subject.'—*Report on Labourers' Wages*, p. 8, 1824.

† At page 19 will be found a printed form of such summary or abstract of the annual receipt and expenditure of a parish.—*Appendix to the Report of the Select Committee on the Poor Laws*, 1819, paper 529. Such an abstract should be distributed, or placed on the church door, to prevent mismanagement.

potent, old, blind, and such other among them being poor and not able to work.'

In this concise form of words, which should never be for a moment lost sight of by those who administer the poor laws, are described at once the persons to whom, and the mode in which, parochial aid is to be given. The evils to rich and poor, but chiefly to the latter, which have arisen by deviating from this statute, are incalculable; and a steady but gradual return to its wholesome enactments seems the only way to avoid still more severe and extended calamities.

It appears that those to whom parochial aid is to be given are divided by the law into two classes, *viz.*, 1st, certain persons who are able to work, who are to be set to work; and 2ndly, the lame, &c., 'others being poor and not able to work,' who are to have necessary relief. The law has thus distinctly marked out two classes, and the different mode in which they are to be treated; and it is of the utmost consequence to the happiness and independence of the humbler ranks that the law should be followed up in practice.

We proceed to make a few remarks on the manner in which this statute should be executed, beginning with those last mentioned in the act, 'being poor and not able to work.' The persons enumerated are the 'lame, impotent, old, blind, and *such* other among them being poor and not able to work;' and in this class is comprised illegitimate orphans and deserted children, with the children, too young to be set to work, of impotent paupers maintained by the parish; to all these 'necessary relief is to be afforded; by which either pecuniary aid or other assistance, derived from 'competent sums of money raised,' appears to have been intended.

Some of the unfortunate persons belonging to this class may best be assisted by allowance from the poor rate, at their own houses, or whilst living with their relatives or friends; and there can be little doubt that, in some instances, this would be the cheaper plan for the parish, as well as most acceptable to the receivers. As, however, applications for such allowances are often unreasonable, and it is necessary for the parish officers to have a power of discriminating in the mode of support given, according to the character and conduct of applicants, it will be of the greatest consequence that they should be able to refuse giving any allowance in money; in which case they must have provided a poorhouse as a receptacle for the impotent poor, where they can be properly maintained.

It will be evident, also, that, besides those who *might* be supported by allowance elsewhere, there must be many, having no relatives or friends to receive them, for whom a home must be provided. These will generally be either the young children, or aged and infirm persons; and a moment's thought will be enough to show that, as far as possible, these should be kept separate. The aged inmates of a poorhouse are frequently of depraved and degraded dispositions; their minds are always soured with disappointment and regret; and they are, of all persons, those with whom young children, whom it is intended to bring up as decent members of society, ought not to associate.

One of the first things necessary in the due regulation of a poorhouse, will be a proper classification of its inmates; even the most infirm will be able to do some work, and as much work should be required from each as is consistent with health and comfort. For this purpose, by a little forethought, some employment may easily be provided. With constant

occupation, being treated with firmness, devoid of undue severity, even the most refractory may be governed without much difficulty. Humanity and good policy, enforced by the law, require that a difference should prevail in the mode of treating those who have been stricken by unmerited infirmity or calamity, from those whose misfortunes are the offspring of their idleness or intemperance.

At last, however, we must confess, it will be a hopeless task to reform, or even much to improve, the aged inmates of a poorhouse; and we must be content that it should remain a receptacle where the miserable are sheltered from starvation, and rescued from the temptations to crime arising from actual want. Its chief use will be to deter persons from having recourse to it, and to stimulate their industry and forethought to preserve their independence. For this essential purpose, a poorhouse ought not to have the appearance of being too comfortable; whatever regulations are laid down should be strictly adhered to; whilst necessaries are allowed, indulgences of all kinds should be curtailed; and such wholesome restraints kept up, as shall prevent any, who are without its walls, from relaxing their exertions to keep out.

With respect to the children, we may entertain very different hopes: they will probably grow up according to the training they receive; and if they have early had bad examples set before them, it is of still more consequence that they should be duly educated. This is of great consequence to the parish in a pecuniary as well as in a moral view. We all know that parish apprentices are now looked upon as great evils, instead of being sought after, as likely to become useful servants or assistants.

Nor is this without reason. Brought up, for the most part, amid vice and wretchedness, without the salutary controul of parents, and their education greatly neglected, it is not extraordinary they should frequently turn out idle and depraved, instead of becoming industrious and independent. They often entail cost upon the parish during their whole lives, and sometimes leave a legacy of miserable, diseased, and vicious children, to be supported after their deaths. Should they have obtained a settlement elsewhere, the evil is not less to the community, and each parish must bear its share in this partition of evil.

It is, therefore, a measure of *parish economy*, as well as of true humanity, to educate properly those deserted or destitute children who are cast upon the parish for support. For this purpose, they should be separated from any contact with the aged inmates of the poorhouse, and should at first be assembled in infant schools, where they will learn a little good, and avoid a great deal of evil, never to be afterwards eradicated. When old enough, they should be further instructed, at the parish expense, in what is fitting to make them useful members of society, until they are able to get their own living. It will seldom, indeed, happen in any parish, that there is not some benevolent person, either belonging to the select vestry, or known to the overseer, who will take pleasure in superintending, to a certain extent, the school for these poor orphans, and seeing that their education is not neglected. Though the names of such persons be unknown, and their acts unseen, they are fellow-workmen with the greatest and wisest of mankind, to improve the condition and increase the happiness of the human race.

Just in proportion as these parish children are properly educated or neglected, will be their chance of obtaining situations to earn their subsistence, and the probability of their keeping from being a future burthen to the parish. This important duty of overseers is, in many country dis-

tricts, totally neglected; the parish children are almost entirely uneducated. With bad examples before them, and no principles to guide them, they become hardened and depraved, and generally end their lives as paupers or criminals. Whoever considers this subject with the attention it deserves, will come to the conclusion, that one-twentieth the trouble and cost expended to repress and punish crimes, would, if early directed to improve and direct the ductile minds of children, have a much wider and more permanent effect. This subject has been well adverted to in the excellent Report of the Committee on the Poor Laws, in 1817, to which we shall hereafter advert.

We cannot refrain, before leaving this part of the subject, from insisting again on the necessity of *infant schools* for the very young: those admirable institutions have been found, in every instance, highly beneficial. The trifling cost, even in saving the clothes of the children and preserving their health, will be repaid. Let no one run away with the false notion, that these are schools for learning or places of confinement; they are places of exercise and amusement, where attention is easily awakened, where bad passions are corrected, and good feelings instilled. Whoever has seen one of these institutions properly conducted, and has witnessed the children coming voluntarily and cheerfully to its doors, will be quite undeceived in this respect. Such a school there ought to be in every populous parish; small ones might join together for this purpose. Wherever a large poorhouse, for the use of several parishes, is established, which in some districts is the case, an infant school should be an indispensable adjunct, from whence the inmates may be removed to one fitted for children of more mature age.

It has before been observed, that, independently of the necessity for a poorhouse to receive those paupers who are entirely destitute, it is of the greatest use to prevent imposition, more especially from idle or ill-disposed parishioners, resident in other and perhaps distant parishes. If, on their application for relief, an immediate offer is made to take them into the poorhouse, a great proportion will either decline the offer and shift for themselves, or very soon leave it after experiencing its regulations; so that the expense of the poorhouse is not to be measured alone by the cost of those *within* its walls, but its saving to the parish must be estimated by a fair consideration of the number of those whom it prevents from imposing on the funds for the poor *.

Having briefly considered the regulations and use of a poorhouse, for the purpose 'of giving necessary relief to the impotent, and others, being poor and not able to work,' it will be necessary to look to the other important directions of the statute which overseers are bound to follow, viz. 'setting to work the children of those who shall not, by the said overseers, be thought able to maintain their children, and for setting to work all such persons, married or unmarried, having no means to maintain them, and following no ordinary and daily trade of life to get their living by.' We may here borrow a little from the Report of a late Committee on the abuses of the poor laws†. 'Your Committee,' says this report, 'refrain from considering what was the meaning attached to the words of the

* By a steady adherence to this improved system under a Select Vestry, the following change took place in Liverpool, notwithstanding an increase in population of 10,000 persons.—1821, 4,717 paupers, cost 36,013*l.*: 1827, only 2607, cost 19,395*l.* —— *Ellis, Esq. Evidence before Poor Law Committee*, 1828.

† Report of Select Committee on that part of the poor law relating to the employment and payments of able-bodied persons from the poor rate, 1828.

statute when it was enacted, however interesting such an inquiry might be; but on this head, they venture to refer to the laborious and valuable investigation to be found in the report on the poor laws in 1817, and the report in 1819. It appears to your Committee, that under the construction now generally put upon these words, it has been held that all parishioners, not able to maintain themselves, have a right to employment by the parish.' It does not, however, appear, that justices have any power, under an order of relief, to enforce this supposed right of employment, which rests upon the discretion of each overseer, who is liable to punishment by law for abusing the power vested in him. 'Whether a man has no means to maintain himself,' and whether a parent 'can maintain his children,' appear to be 'questions letting in a wide discretion, on the part of overseers, as to the facility or difficulty with which they will comply with the requests of persons demanding parochial employment *.'

It would be irrelevant to our present purpose to show here, why it is advantageous to the poor themselves, that this discretionary power should often cast difficulties in the way of those calling upon parishes 'to effect the impracticable purpose of finding employment for all who may at any time require it.'

Whoever were the persons to whom the Act of Parliament extended, and with whatever discretion it may be exercised, one thing is clear, that the relief was to be afforded in one way, viz., '*by setting to work.*' It is, therefore, the first duty of those who have the execution of the poor laws entrusted to them, to provide the means of executing (when it is necessary) this important part of the law. It matters not to say 'the execution of the law is difficult,'—the more will it require our forethought and firmness to carry it into effect. But a little consideration will show us, that the difficulty is exaggerated, and will make apparent to us the numerous evils arising from neglect in the due execution of the law.

Those directed to be set to work are of two descriptions; first, children; second, persons having no means to maintain themselves, and using no ordinary and daily trade of life to get their living by.

'Though the persons entitled to relief, and the sort of relief, seem to be pointed out with sufficient clearness, yet the practice has, in many instances, long been at variance with the law. The statute directs the children to be set to work; the almost general practice is to give money to the parents, without setting the children to work.'

The able report, from whence we borrow this account †, goes on to point out the many evils arising from this deviation of the law, and the necessity of returning to the true system: an extract is there given from a Report of the Board of Trade on this subject, drawn up by the celebrated Mr. Locke in 1697, and well worthy our attention. In like manner, instead of providing employment for the other class to whom the law says it is to be given, money allowances are, in many instances, in the south of England, made instead. We will borrow the words of the Report of a late Committee on this subject. 'In some parishes, a weekly allowance is made to able-bodied labourers, without any employment being given; in others, they are put up to a kind of auction, as servants, to the best bidder, the difference between the amount paid and their sustenance being paid by the parish. The practice of allowance from the

* Report of Committee, 1828, p. 4.

† Report of Select Committee of House of Commons on the Poor Laws, p. 27, Oct. 1817.

poor rate for the children of labourers appears to prevail very generally in several of the southern counties subsequently named; nor is this at all confined to particular instances of distress from accidental circumstances, but it is adopted throughout large districts as a general rule, from which there is no departure, and to which, by custom, the married poor look as completely a matter of right. In some counties, it appears, the allowance for children is fixed and invariable, according to their number; and in others it is regulated by the price of bread, allowing a certain quantity per head for each member of a family. The Committee on Labourers' Wages, in 1824, lent close attention to this part of the subject; nor can your Committee do better than borrow their words.' After stating that in the northern parts of England these practices do not prevail, and that the wages there are good, they proceed to say, 'in Suffolk, Sussex, Bedfordshire, Bucks, Dorsetshire, and Wiltshire, the plan of paying wages out of the poor rate has been carried to the greatest extent. Norfolk, Huntingdonshire, and Devonshire are also afflicted with it.' 'Your committee,' (continues the report of 1828,) 'do not find reason to believe that any material improvement has taken place in the counties alluded to in this respect, and in parts of Kent, Hertfordshire, Hants, Surrey, Essex, Cambridgeshire, Middlesex, Berks, and Oxfordshire, the same system has been acted upon *.'

The consequences of the practice above described is stated in the former report in the following words:—'A surplus population is encouraged; men who receive but a small pittance know that they have only to marry, and that pittance will be augmented in proportion to the number of their children. Hence, the supply of labour is by no means regulated by the demand; and parishes are burdened with thirty, forty, or fifty labourers, for whom they can find no employment, and who serve to depress the condition of their fellow-labourers in the same parish.'

An intelligent witness, who was much in the habit of employing labourers, states, that when complaining of their allowance, they frequently say to him, 'we will marry, and you *must* maintain us!' 'By far the worst consequence of the system is' (adds the report), 'the degradation of the character of the labouring class †.'

In very many parts of the wide district to which the above extract applies, it is to be lamented that the magistrates (instead of endeavouring gradually to prevent these abuses, and to bring the practice of the law to what is warranted by the statute, and the example of the north) have been themselves the first to sanction and confirm these abuses. In some counties, the justices have adopted and enforced the worst form of deviation from the law, viz., a uniform scale of money allowance from the poor rate to every able-bodied labourer, graduated according to the number of his children and the price of bread. However benevolent the intention of the framers of such a scale might be, we cannot but consider it as a most mischievous invention, utterly subversive of the independence, industry, and happiness of the poorer classes.

It appears, also, that in many parts of the south of England, if the overseers or managers of the poor rate had any scruple (as, if ever they looked at the law, they might have had) in obeying the impolitic and ille-

* It will be seen, that all the districts in which riots have occurred amid the rural population, and where Special Commissions have, in consequence, been held, were named among these tainted counties. In Sussex, Wilts, and Bucks, the evil practice is perhaps most prevalent. The fires also have been almost confined to the counties mentioned in the text.

† Report, 1828, p. 6.

gal recommendations of the magistrates in this respect, by a forced and improper construction of a single ambiguous word in another part of the act, these scruples were effectually silenced.

On turning to that part of the statute which directs relief to be given to the lame and others, being poor and not able to work, and which empowers relief to be ordered by one magistrate, we find among those entitled to such relief, *the impotent;* and this has been frequently construed, throughout the southern counties, to extend to the young children of labourers or others, who are not thought by any magistrate able to maintain them, either from casual want of employment, the low rate of wages, or any other cause. We may remark, that these abuses appear to have had rise in mistaken benevolence during the high prices and rapid fluctuation in the value of bread from 1795 to 1815.

The pretence for any such practice is removed, but the evil arising from it is in full force. It cannot be necessary to enlarge upon the effects of these abuses, which are pointed out in the reports cited. It may be sufficient to say, that all the committees * who have considered the subject, and every writer, of the least authority, who has treated upon this matter for several years past, concur in deprecating the continuance and extension of the system.

Its effects are described as lessening forethought and industry, stimulating population where there is no adequate employment, depressing the *natural rate of wages*, and lessening the value of the poor man's sole possession, viz. his labour.

The Committee of 1828 state that, 'wherever the practices adverted to prevail, they have found there is a redundancy of labour, and that a proportion, varying from one-fifth to one-twelfth the number of able-bodied labourers belonging to the parish, are assisted by parish allowance or employment during several months of the year. The consequence of this redundancy is, that the wages are very low; as the labourers, exceeding in number the demand for their services, undersell each other in the market for employment; and being underpaid, become degraded, go to the parish-rate as a matter of course, and lose the hope of improving their condition by their own efforts.

'As, then, it appears,' says the Report, 'to your Committee, that the actual redundancy of labour is the principal source of the low wages and misery of the peasantry, it seems of consequence to consider whether that redundancy is kept up by anything in the practices alluded to?—because, if that *is* the case, it will follow that *low wages give rise to the practice of allowance, and the system of allowance reacts to keep wages low; so that, without some change in that which is alternately cause and effect, the evil may be continued in a vicious circle almost without limit.*

'In shortly stating the important principle which regulates the supply of labour, the Committee avail themselves of the words used in the Report on the Poor-Laws, in 1819, p. 7: "That the demand and supply of labour have, in the natural course of things, such a tendency to regulate and balance each other, (unless counteracted by artificial institutions,) that any excess of either arising from temporary causes, would, if met by temporary expedients, in no long time correct itself†."'

* Report on Poor Laws, 1817; Ditto ditto 1819; Ditto on Labourers' Wages, 1824; Reports on Emigration, 1826, 1827; Report on Criminal Commitments, 1827; Report on Abuses of Poor Law, 1828.

† Report, 1828.

We lament to say that these abuses of the poor laws, though chiefly prevalent in the southern counties before enumerated, are beginning to be introduced in some of the manufacturing districts. In the neighbourhood of Coventry it has made some progress among the silk weavers; and in the vicinity of Leicester many of the stocking weavers have had their wages made up from the poor rate*. Hence the returns and accounts of the sale of productions made by these workmen form no criteria of the real state of trade, which is kept up or extended at the expense of the rate-payers, who pay a portion of the miserable wages received by the men. Much better were it to slacken the supply of goods, till the demand rose to afford a just and honest remuneration for employment†.

It may not be improper to remark, even putting aside the injustice and impolicy of these practices, that, instead of really proving a saving to the employers, as they sometimes vainly suppose, by keeping wages low, these abuses cost, in the form of poor rate, and all the evils such a system engenders, much more than would pay the workmen ample wages ‡.

We will now turn to consider the means which should be taken in a parish where these abuses have some time prevailed, gradually to discontinue them. We must suppose that, in such a parish, there is a superabundance of labourers at one or other time of the year, beyond the employment for them at adequate subsistence wages. We will suppose this superabundance to be one-twentieth of the whole number. In either case, (that is, whether supported by parish work or parish allowance,) the cost will be nearly the same to the rate, but the effect to the men very different. If allowance be made from the rate in addition to wages, the whole number of men compete with each other for what work there is,—those assisted by the parish bounty underselling those without it, till the wages of the whole fall to such a point that all are obliged to have allowance, and all become reckless and careless as to their own exertions. If, however, the superabundant labourers be aided by employment found for them by the parish, they do not undersell the independent workmen, who are thereby enabled to earn adequate subsistence wages, and, being fairly paid, will exert themselves to maintain their independence.

Let us see then how, in such a parish, parochial employment may be provided, and what must be the nature of the employment.

i. We must try to create additional employment in a particular spot.

ii. It must interfere as little as possible with the ordinary work of the neighbourhood.

iii. It must in itself, or the mode in which it is recompensed, be rather distasteful to those who receive it§.

iv. It should be as much as possible of a temporary nature, and capable of increase or diminution, according to the exigency of the time.

* We feel convinced some mode of assisting working manufacturers, during temporary fluctuations in the demand for labour, must be devised; either by giving them facilities and inducements to insure themselves, or by providing employment at low wages ready for an emergency. Our poor laws afford little aid in this matter, and were enacted before the great bodies of men to whom we refer were in existence. Neither can we neglect this subject without danger to all around us.

† Report on Manufacturers' Employment, 1830.

‡ In some instances, the immediate effect may be to lower wages, and the tenant supposes he is hereby benefited, though at the expense of permanently raising the rates, which must ultimately be deducted from rent. If proprietors and agents have the least perception of their own interest, separate (if it ever can be separate) from that of the working classes, they will immediately check such an abuse.

§ Report on Labourers' Wages, p. 7. This excellent Report was drawn up by Lord J. Russell.

It is not necessary to echo the common statement, that we have here a difficult task to perform.

The first thing to be done is to provide a workhouse, fitted for the reception of those who apply for employment and their families, and provided with adjacent work-yards for whatever work is in the particular vicinity found most eligible. To this may be added a small parish farm, which may be worked by spade husbandry. In the work-yards bricks and draining tiles may be made, stone or wood sawed, and other employments of a like nature carried on*. But it should never be supposed for an instant that any parish farm or fabric can pay for itself, much less make any profit. We must be content if, at an expense of one-third or one-half the workman's subsistence, we can support him out of temptation to crime, without injuring the independent workmen of the parish, and yet give the parish labourer his subsistence in such a form as to incite others to avoid his situation, by forethought, diligence, and exertion.

It will be a main point to be able to lay down as a general rule, that whoever comes for parish employment, shall come to be at the workhouse altogether, and with their families shall reside there; when there, they will be supported and employed entirely by the parish. The importance and good effect of this regulation has been shown in numerous instances, as in Liverpool and many other places†.

It is not our intention to state that parochial employment should never be given to able-bodied persons, unless they become resident in the workhouse; but this ought to be the rule, and the parish work to out-dwellers the exception. By this means it will be in the power of the select vestry, or their accountable officer, to act according to circumstances and the known character and conduct of the applicant; and this would go a great way towards deterring idle applicants and stimulating all workmen to industry and forethought. Another important advantage arising from this regulation will be, that it will draw a broad line of distinction, which should ever be preserved, between independent and parish workmen.

A benefit of as much consequence is, that this regulation will enable the managers of these workmen to find them in food, clothes, and other necessaries, instead of paying them money wages; hereby preventing waste, and at the same time putting single and married men (whose families will be supported in the house) on a level in this respect. If paid in money, the married man, under pretence that he must be paid according to the number of his family, will receive more than the single man, and often divert it to his own purposes, leaving his family to suffer; besides making the single man discontented, who will naturally (seeing he loses instead of gains by not marrying improvidently) resolve to marry without regard to consequences.

A portion, however, of the remuneration to parish workmen should be given or kept for them in money, according to the quantity of work they

* Mr. M'Adam, in his evidence before the Committee on Labourers' Wages, in 1824, stated that, under the improved system of road-making, the proportion of expense would be two-thirds for manual labour, one-third for cartage; whereas formerly those proportions were reversed. He says, a very fruitful source of employment might be found in parishes undertaking to supply the road trusts with materials prepared for repairs; and states, the work to be done is *chiefly in the winter and spring months*, and women and children may earn their share.—pp. 13—15.

† Report on Abuses of the Poor-Laws, 1828, Appendix; Evidence of Messrs. Hale, Ellis, Bucknall, &c.

do; hereby encouraging their exertions, and forming a small fund, by aid of which they may again emerge into independent work as soon as opportunity offers.

In order to carry these regulations into effect according to law, it will therefore be necessary for each parish, *where there are likely to be any number of applicants* for employment, to have a workhouse, and this they are empowered by law to provide if they are without. In some cases, however, and for small parishes, it will be a better plan to join (according to the provisions of the Act 9 Geo. I. c. 7.) with some adjacent parishes, for providing, by hiring or erecting, some suitable building as a joint workhouse, of which the cost shall be paid, however, *according to the number of inmates* sent by each parish each year; the fixed expenses of the establishment being paid by a proportion settled for each parish beforehand.

One of the most difficult parts of the duty of the permanent overseer or select vestry, will be to devise employment for parish workmen, consistent with the rules before stated; yet is it the most important. Above all, they must never bring the parish men into competition with independent workmen, so as to lower the wages of the latter; nor accept employment which would have been given to others in the neighbourhood. Yet there are, in almost every parish, or in every neighbourhood (for it by no means follows the work should be within the parish), various jobs of work in draining, clearing water-courses, filling up or emptying pits, cutting off angles of fields, removing banks, and other similar occupations, which it would answer well to the proprietor or tenant to have done at one-half or two-thirds the usual wages, but which he would never undertake unless induced by such an advantage. For such works the overseer may contract, receiving the price stipulated from the proprietor employing parish men, and paying them whatever is necessary. Here is so much new employment induced by the cheapness of labour; so far easing the parish rate, and not injuring independent workmen; for without such inducement it would not have existed; and yet, by its result, it contributes to the capital of the country, and the future additional employment of labour. Perhaps a good rule would be never to take any work of which the proprietor paid more than two-thirds the subsistence wages; for otherwise he might then, or soon after, have, perhaps, employed independent workmen himself.

Many landed proprietors, in such an emergency, on seeing the overseer zealously seeking out fresh employment, such as we have described, would come forward to make some ornamental alteration in their grounds, to cut a private canal or piece of water, or in some way furnish new work; perceiving, as they would, that by as much as they thus gave towards the wages of labour, by so much did they relieve the rates which were paid by themselves or their tenants; so that they would gain with one hand as much as they would lose with the other; and this is an answer to what would otherwise be a good objection,—'That such proprietors, by withdrawing their expenditure in some other way to lay it out in such bribed or induced improvement, only take it from the support of independent mechanics or workmen elsewhere to assist parish workmen at home.'

A still more difficult case may arise, however, than that we have been considering. There are, unfortunately, parishes where the abuses described have prevailed for a very considerable time, where many have

married and brought up families, depending on this parish allowance for each child; and where, in consequence of this parish bounty thus illegally offered on improvident marriages, there is a large proportion of workmen for whom it is impracticable to find any independent employment in or near the parish. It is clear that it would be very harsh and unjust to condemn to residence in a workhouse those whom our own neglect and misconstruction of the law have placed in their present position; yet as long as they remain in the parish without additional employment, they must compete with and undersell all the other workmen, who would otherwise be enabled to gain enough to maintain their families independently. With regard to new applicants for parish assistance, there will be no injustice in giving notice (and this should be enforced by a declaratory Act of Parliament) that, *for the future*, the law will be adhered to*, and that parish assistance will alone be given in the form and mode described by the statute, and as administered in the northern parts of England.

What are we then to do with the labourers, redundant as regards that particular parish, for whom we are bound, if not by law, yet by justice (owing to our own neglect) to find comfortable employment.

It will be the cheapest, and the most just and politic way, to face the difficulty at once. We will suppose, in the parish in question, there are one hundred labourers, and one-tenth (ten) are without independent employment, unless by competing with the other ninety, some or all of whom will become partially dependent on the parish.

These ten men, we will suppose, will, with their families, require each 10*s.* per week for their support, that is in all 260*l.* per annum. This, therefore, will be their expense, supported by the parish either in idleness, or partial work *taken from the other workmen.* This 260*l.* will be to be borne by the parish during the lives of these ten labourers, and of such of their families as would stand in their places.

How then can we best provide for these men, whom we must somehow support? It is evident we must either remove them to some other place, where labour is not redundant, and where the value of their work may support them, or we must in some way create additional employment within their reach at home. We will first consider the latter alternative, as the most easy of execution, and practicable with little or no change in the law as it stands†.

The plan we propose is, for the parish or individual proprietors (led, as we shall see, by interest as much as humanity) to offer to the unemployed labourers for a term of years, at a low fixed rent, such a portion of land, to be worked principally by spade husbandry, as shall be sufficient for the support of their families. (Let not our readers exclaim impatiently against us, but follow out the considerations we lay before them.) We suppose this quantity to be on an average about six acres, (but this will be regulated by the quality of the land, size of the family, &c.) It will be necessary to erect on these spade farms such small buildings or sheds as may be necessary for their cultivation; by the plots being adjacent to each

* This may be done even without a declaratory Act, by the justices at sessions resolving and stating publicly their resolution to adhere to the law, as acted on for the most part in the north; but, at the same time, the most strenuous and extensive exertions must be made for the employment of those aided from the parish during the transition to a better system.

† Voluntary emigration, properly conducted, may, in some cases, be preferable; but requires details beyond what our limits will allow.

other, one small barn centrally situated, to be used in a certain rotation by each, may serve several workmen. A stipulation must be made in the leases, that there shall be *no division or under-letting*, and that no such labourer *shall work for any one but himself, except in the harvest month.* A sufficient outfit in stock, seeds, tools, &c., must be found for those in want of them to begin with.

Each unemployed labourer would thus be changed into an employed workman supporting himself, or into a spade farmer working his own land, on an assurance that, *according to his industry* and care, would be his gains and the condition of his family; and thus the strongest motives, which have been found effectual in all other conditions, would be brought to bear on his mind. As he found his state improve and hope broke upon him, his efforts would be redoubled to maintain his place.

Let any one compare the produce of six acres trenched, pulverised, and worked like a garden, with the produce of the same land comparatively neglected. This subject has been considered by many intelligent practical men; and though some were at first distrustful of our calculations, on examination they have almost universally become convinced we were right*. We do not say there are not difficulties to be overcome; but they are not insuperable; we have but a choice of difficulties, and the advantages to be derived from success in such an experiment are incalculable.

In the agricultural operations necessary to be carried on in a spade farm, there will be occupation for the workman's wife and children; the latter will thus early be brought up in habits of industry and obedience: the great difficulty will be to prevent the exhaustion of the land by over-cropping; but this may be avoided by judicious regulations as to rotation of crops, and a well-considered plan for keeping up a stock of manure†. When this is once thoroughly understood by the working tenant, he will be convinced it is his *own* interest to follow it; and there is no bond like self-interest.

In many well-cultivated cottage gardens, wheat and potatoes succeed each other as crops for many years; such a course would be very injurious in ordinary husbandry; but the exhaustion of the land is compensated by extra manure, and the more perfect working of the soil by hand labour. It is well known that in dry weather turning up and stirring the earth in drills refreshes the crops almost as much as rain.

By keeping pigs, or perhaps a cow (tied up in a shed and soiled as on the continent), every bit of refuse may be consumed on the premises, and much manure be returned to the land.

Every agriculturist, acquainted with the fertility arising from the pulverisation and frequent stirring of the earth, as detailed by the best writers on husbandry, will allow our expectations are not over-sanguine.

The occasional hire of a horse and cart, to bring home the crop or to fetch a load of lime, may sometimes be wanted; the rest will be done by hand or with a barrow.

The experiment of these spade farms has been made on a sterile soil in Holland with great success, and we refer with pleasure to the accounts and details of those trials. The cost of the necessary outfit may be raised from the parish rate, in order 'to set the poor to work;' and by the

* Lord Braybrooke's account of the success of some spade farms in Essex.

† In the account of the poor colonies of Holland are some valuable accounts of the mode of economising and increasing the value of agricultural manure.

59 Geo. III. c. 12 the parish is empowered to rent twenty acres for the same purpose.* But we feel convinced that many land-owners, when once this plan had been fairly tried, would themselves commence such spade farms, where there were redundant labourers, both from motives of humanity and policy. It has been said, on the one hand, that labourers will be so fond of having an independent bit of land in their own management that the best labourers would be desirous of becoming such tenants; this would very probably be the case. In consequence, they would want less outfit, and the benefit would be the same to the community, as thereby a number of workmen equal to those unemployed would be taken out of the labour market, and the wages of the rest would rise so as to maintain them in independence. Supposing, however, instead of earning on their spade farms *quite* enough for the maintenance of their families, as we believe they would,—supposing, for instance, 26*l.* per annum being necessary, they only earned 20*l.*, what would be the consequence?—that the parish, or their landlord, by means of a gift of coal, corn, seed, or some indirect assistance, should make up the difference until they were able to walk alone. In the interval, the parish will have gained all that they save by the man's own gains, for before, they had to support him entirely; the condition of all the other workmen will be improved by the removal of his competition for their employment, and the man himself, fully and beneficially occupied, will be contented, because he has a fair prospect of improving his condition, and knows the fruits of his industry will be his own.† If on a farm of 100 acres, under the common system, two labourers are constantly employed through the year, the same land divided into spade farms as proposed would find occupation for sixteen, and supersede there, in great measure, the use of horse labour.

These benefits are not to be gained without pains and perseverance; but the experiment is absolutely necessary, and will well repay any benevolent proprietor or rate-payer the trouble necessary to attain success. It must be gratifying to think that, instead of being unpopular among the poor, they would be eager and grateful to embrace the proposition made them;—the regulations necessary must be well considered, and firmly adhered to, especially that of each man being *constantly employed on* his own land.

Let it be remembered, at last, that this plan ‡ is not recommended for general or permanent adoption, but only as a *temporary* means of lessen-

* By a late act extended to fifty acres.

† We may add, that if, under the proposed plan (which would at least be popular with the peasantry), we had to pay the *whole* of the cost of their subsistence (26*l.* per annum each), it would still be much more to our interest than to continue the allowance system, because, in the latter case, the cost is *perennial*, in the former, it ends with the lives of the annuitants.

‡ We will mention two plans for the assisting of agricultural labourers, not directly connected with the subject before us; but will yet, we hope, be useful, and may either of them be carried into effect by benevolent landholders. The first in action in several places, is very simple. The landlord, or a society raising the funds by subscription, offer to any labourer who will lay by sixpence, or any smaller sum, per week, to add to it half the amount at the end of the year, and lay out the whole in some useful thing to be given to the contributor. This has been found popular among the peasantry, and might, with some changes, be adapted to towns also. The second is general in several parts of Holland, and consists of an insurance office on a simple principle, established and guaranteed by the local authorities and persons of property, in which workmen and labourers, by paying a small sum, can insure, in case of death, a provision for their widow and for each child, till old enough to support himself. In one part of Holland we were told the female peasantry used to consider this right of dower as greatly favourable to the claims of any suitor.

ing a great existing evil DURING A TRANSITION from a bad administration of the poor laws to an improved system! It is essentially different from any plan of dividing farms into various cottage holdings, and building *new* dwellings therein, which would only stimulate population, increase the number of labourers in a particular district, already too full, and thereby eventually much augment instead of diminish the evil complained of.

*March*, 1832.

## ABSTRACT OF PAROCHIAL EXPENDITURE.

*Parish of*

| | 183 | 18 Past Year | More. | Less. | Cause of Difference. |
|---|---|---|---|---|---|
| Poor's Rate in Year . . | | | | | |
| Rate in Pound in Year . . | | | | | |
| Rate in Pound on Rack Rent . | | | | | |
| Highway Rate . . | | | | | |

## EXPENDITURE OF POOR RATES.

| | | | | | | |
|---|---|---|---|---|---|---|
| | County Rate . . | | | | | |
| 1 | Infirm and Poor . | | | | | |
| | In-Poor—Cost . . Number . . | | | | | |
| | Out-Poor—Cost . Number . . | | | | | |
| | Illegitimate and Orphan Children } Cost / No. | | | | | |
| 2 | Able Bodied—Cost . and Number . | | | | | |
| | By Work . . If otherwise, How? | | | | | |
| | Casual Poor . . | | | | | |
| | Law Expenses . . Salaries . . | | | | | |
| | Repairs, Rent, Stock, &c. . . | | | | | |
| | Population from Returns . . | 1821 | 1831 | | | |
| | General Observations on State of Poor, &c. | | | | | |

LONDON:
PRINTED BY W. CLOWES,
Stamford Street.

(4)

# THE SHEEP: their breeds, management and diseases. By William Youatt. London. 1838.

## Chapter I.

**The Zoological Character of the Sheep—The different Names applied to it according to its Age—The Marks by which its Age may be ascertained, and the natural Duration of its Life—Description of the Teeth.**

The Sheep, according to Cuvier*, belongs to the Order Ruminantia; having teeth in the lower jaw only, opposed to a callous substance in the upper jaw; six molar teeth on either side, and the joint of the lower jaw adapted for a grinding motion; four stomachs, and these, with the œsophagus, so constructed that the food is returned for the purpose of rumination; long intestines not cellated:

—the Tribe Capridæ; the horns, where they are found, being permanent; placed on a vascular bony basis or process; the horny sheath receiving its increase by annual ringlets at the base, forming deep sulci around the horn, with others as deep running longitudinally, and dividing the surface of the horn into a succession of irregularities or knots. The general structure light, and adapted for springing or swiftness; the ears usually erect and funnel-shaped; the pupils of the eye oblong, and there not being any canine teeth in the mouth:

—the Genus Ovis; with or without horns, and these, where present, taking more or less a spiral direction; the forehead or outline of the face convex; no lacrymal or respiratory opening under the eye; the nostrils lengthened and terminating without a muzzle; no beard; the body covered with short close hair with a downy wool beneath, and, in a domestic state, the wool prevailing over the hair, or quite superseding it; the legs slender, yet firm, and without brushes or callosities.

Of these there are three varieties: the Ovis Ammon, or Argali; the Ovis Musmon, or Musmon; and the Ovis Aries, or Domestic Sheep. The two first will be described in a future chapter, the last will form the principal subject of this work.

There is considerable resemblance between the ovis or sheep, and the capra or goat, another genus of the tribe Capridæ, the history and uses of which will be described in the after part of this volume. The distinctions between them are chiefly these: many sheep are without horns; the horns of sheep have a spiral direction, while those of the goat have a direction upwards and backwards; the forehead of sheep is convex, and that of the goat concave; the sheep has, except in one wild variety, nothing resembling a beard, but the goat is bearded; while the goat, in his highest state of improvement, and when he is made to produce wool of a fineness unequalled by the sheep, as in the Cashmere breed, is mainly, and always externally, covered with hair, the hair on the sheep may, by domestication,

* Animal Kingdom, Synopsis.

be reduced to a few *kemps* (coarse hairs), or got rid of altogether; and finally, the pelt or skin of the goat has a thickness very far exceeding that of the sheep.

Agriculturists have applied different names to the sheep according to its sex and age.

The male is called a *ram* or *tup*. While he is with the mother he is denominated a *tup* or *ram-lamb*, a *heeder;* and in some parts of the west of England, a *pur-lamb*. From the time of his weaning, and until he is shorn, he has a variety of names: he is called a *hog*, a *hogget*, a *hoggerel*, a *lamb-hog*, a *tup-hog*, or a *teg;* and, if castrated, a *wether hog*. After shearing, when probably he is a year and a half old, he is called a *shearing*, a *shearling*, a *shear-hog*, a *diamond* or *dinmont ram*, or *tup;* and a *shearing wether*, &c., when castrated. After the second shearing he is a *two-shear ram*, or *tup*, or *wether;* at the expiration of another year he is a *three-shear ram*, &c.; the name always taking its date from the time of shearing.

In many parts of the north of England and Scotland he is a *tup-lamb* after he is salved, and until he is shorn, and then a *tup-hog*, and, after that, a *tup*, or if castrated, a *dinmont* or a *wedder*.

The female is a *ewe*, or *gimmer lamb*, until weaned; and then a *gimmer hog*, or *ewe hog*, or *teg*, or *sheeder ewe*. After being shorn she is a *shearing ewe* or *gimmer*, sometimes a *theave*, or *double-toothed ewe* or *teg;* and afterwards, a *two-shear*, or *three-shear*, or a *four* or *six-tooth ewe* or *theave*. In some of the northern districts, ewes that are barren, or that have weaned their lambs, are called *eild* or *yeld* ewes.

The age of sheep is not reckoned from the time that they are dropped, but from the first shearing, although the first year may thus include fifteen or sixteen months, and sometimes more.

When there is doubt about the age of a sheep, recourse is had to the teeth, for there is even more uncertainty about the horn in horned sheep than there is in cattle; and ewes that have been early bred from, will always, according to the rings on the horn, appear a year older than others that, although of the same age, have been longer kept from the ram.

It has already been stated, that sheep have no teeth in the upper jaw, but the bars or ridges of the palate thicken as they approach the fore part of the mouth; there also the dense, fibrous, elastic matter of which they are constructed, becomes condensed, and forms a cushion or bed that covers the convex extremity of the upper jaw, and occupies the place of the upper incisor or cutting teeth, and partially discharges their function. The herbage is firmly held between the front teeth in the lower jaw and this pad, and thus partly bitten, and partly torn asunder. The nodding motion of the head of the sheep is a sufficient proof of this.

This animal is one of those especially destined to support man with his flesh; and that he may be able to do this with the least possible expenditure of food, and to extract the whole of the nutriment which the herbage contains, a provision common to all ruminants (as will hereafter be more fully explained) is made in the construction of the stomachs, and other parts of the digestive apparatus. As the first process by which the food is prepared for digestion, it is macerated for a considerable time in the paunch. The frequent and almost necessary consequence of the long continuance of the food in this stomach, exposed to the united influence of heat and moisture, will be the commencement of fermentation and decomposition, and the extrication of a considerable quantity of injurious gas. This often takes place, and many sheep are destroyed by the distension of the paunch caused by this extrication of gas. The process of fermentation

and decomposition is accompanied by the presence or development of an acescent principle. It has been stated that an elastic pad occupies the place of teeth in the upper jaw; and that it is by a half biting and half tearing action that the sheep gathers his food: the necessary consequence is, that some of the grass, of harder construction than the rest, does not give way, but is torn up by the roots; a portion of the mould adheres to the roots, and is swallowed, and, all our soils containing more or less absorbent or calcareous earth, the acid is neutralized, and, as it were, removed, as rapidly as it is formed; except in some extreme cases, attributable almost entirely to the neglect or thoughtlessness of the proprietor of the sheep.

The teeth of the sheep are the same in number as in the mouth of the ox. There are eight incisor or cutting teeth in the fore part of the lower jaw, and six molars in each jaw above and below, and on either side. The incisors are more admirably formed for the purpose of grazing than in the ox. The sheep bites closer than the ox; he was destined to live where the other would starve: he was designed in many places to follow the other, and to gather sufficient nourishment where the ox would be unable to crop a single blade. Two purposes are answered by this: all the nutriment that the land produces is gathered from it, and the pasture is made to produce more herbage than by any other means it could be forced to do. The sheep by his close bite not only loosens the roots of the grass, and disposes them to spread, but by cutting off the short suckers and sproutings, —a wise provision of nature—causes the plant to throw out fresh, and more numerous, and stronger ones, and thus improves and increases the value of the crop. Nothing will more expeditiously or effectually make a thick permanent pasture than its being occasionally and closely eaten down by sheep.

In order to enable the sheep to bite thus close, the upper lip is deeply divided, and free from hair about the centre of it.

The stalks of the common herbage of the field, bitten thus closely as they are by the sheep, are harder and more fibrous than the portions that are divided and cropped by cattle; and not only so, but some breeds of sheep are destined to live, in part at least, on harder food than falls to the lot of cattle, as the different kinds of heath, or substances almost as difficult to be broken off as the branches of the heath. The incisor teeth are evidently formed for browsing on these dense productions of the soil, which would otherwise be altogether useless and lost. The part of the tooth above the gum is not only, as in other animals, covered with enamel to enable it to bear and to preserve a sharpened edge, but the enamel on the upper part rises from the bone of the tooth nearly a quarter of an inch, and, presenting a convex surface outwards, and a concave one within, forms a little scoop or gouge capable of wonderful execution. He who will take the trouble to compare together the incisor teeth of cattle and of sheep—both ruminants—both by means of the half-cutting and half-tearing action having the stomach, in which the process of maceration is going forward, abundantly supplied with absorbent or alkaline earth—the one, however, destined to crop little more than the summit of the grass, and the other to go almost close to the roots, and occasionally to browse on harder food—will have a not uninteresting illustration of the manner in which every part of every animal is adapted to the situation in which he is placed, and the destiny he is to fulfil. The pad also is firmer and denser than in cattle, yet sufficiently elastic, so that it is in no danger of injury from the sharp chisels below, while the interposed substance is cut through with the greatest ease.

The mouth of the lamb newly dropped is either without incisor teeth, or it has two. The teeth rapidly succeed to each other, and before the animal is a month old he has the whole of the eight. They continue to grow with his growth until he is about fourteen or sixteen months old.

Fig. 1.

Fig. 2.

Fig. 3.

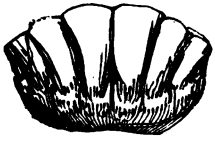

Fig. 4.

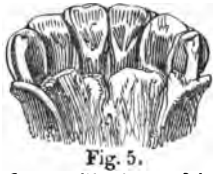

Fig. 5.

Fig. 6.

In the accompanying cut, fig. 1 will give a fair representation of the mouth of a sheep at this age. Then, with the same previous process of diminution which was described in cattle, or carried to a still greater degree, the two central teeth are shed, and attain their full growth when the sheep is two years old. Fig. 2 gives a delineation of the mouth at this age.

In examining a flock of sheep, however, there will often be very considerable difference in the teeth of the hogs, or the one-shears; in some measure to be accounted for by a difference in the time of lambing, and likewise by the general health and vigour of the animal. There will also be a material difference in different flocks, attributable to the good or bad keep which they have had.

Those fed on good land, or otherwise well kept, will take the start of others that have been half-starved, and renew their teeth some months sooner than these. There are, however, exceptions to this; Mr. Price* says that a Romney Marsh teg was exhibited at the show fair at Ashford, weighing 15 stones †, and the largest ever shown there of that breed, and that had not one of his permanent broad teeth.

There are also irregularities in the times of renewing the teeth, not to be accounted for by either of these circumstances; in fact, not to be accounted for by any known circumstance relating to the breed or the keep of the sheep. The same author remarks, that he has known tups have four broad and permanent teeth, when, according to their age, they ought to have had but two ‡. Mr. Culley, in his excellent work on 'Live Stock,' says—"A friend of mine and an eminent breeder, Mr. Charge, of Cleasby, a few years ago showed a shearing-tup at Richmond, in Yorkshire, for the premium given by the Agricultural Society there, which had six broad teeth; in consequence of which the judges rejected his tup, although confessedly the best sheep, because they believed him to be more than a shearing: however, Mr. Charge afterwards proved to their satisfaction that his tup was no more than a shearing §." Mr. Price, on the other hand, states that he "once saw a yearling wether, which became quite fat with only one tooth, that had worked a cavity in the upper jaw, the corresponding central tooth having been accidentally lost."

* Price on Sheep Grazing, &c., p. 84.

† The weights will all be calculated according to the new regulation of 14 lbs. to the stone.

‡ Price on Sheep Grazing, &c., p. 83.

§ Ib. p. 214.

The want of improvement in sheep which is occasionally observed, and which cannot be accounted for by any deficiency or change of food, may sometimes be justly attributed to the tenderness of the mouth when the permanent teeth are protruding through the gums.

Between two and three years old the two next incisors are shed; and when the sheep is actually three years old the four central teeth are fully grown (see fig. 3): at four years old he has six teeth fully grown (see fig. 4): and at five years old all the teeth are perfectly developed (see fig. 6). This is one year before the horse or the ox can be said to be full-mouthed. The sheep is a much shorter lived animal than the horse, and does not often attain the usual age of the ox.

The careless examiner may sometimes be deceived with regard to the four-year-old mouth. He will see the teeth perfectly developed—no diminutive ones at the sides, and the mouth apparently full; and then, without giving himself the trouble of counting the teeth, he will conclude that the sheep is five years old. A process of displacement, as well as of diminution, has taken place here,—the remaining outside milk-teeth are not only shrunk to less than a fourth part of their original size, but the four-year-old teeth have grown before them and perfectly conceal them, unless the mouth is completely opened. Fig. 5 represents this deceptive appearance.

After the permanent teeth have all appeared and are fully grown, there is no criterion as to the age of the sheep. In most cases the teeth remain sound for one or two years, and then, at uncertain intervals, either on account of the hard work in which they have been employed, or from the natural effect of age, they begin to loosen and fall out; or, by reason of their natural slenderness, they are broken off. When favourite ewes that have been kept for breeding begin, at six or seven years old, to lose condition, their mouths should be carefully examined. If any of the teeth are loose they should be extracted, and a chance given to the animal to show how far, by browsing early and late, she may be able to make up for the diminished number of her incisors. It will not unfrequently happen that ewes with broken teeth, and some with all the incisors gone, will keep pace in condition with the best in the flock; but they must be well taken care of in the winter, and, indeed, nursed to an extent that would scarcely answer the farmer's purpose to adopt as a general rule, in order to prevent them from declining to such a degree as would make it very difficult afterwards to fatten them for the butcher. It may certainly be taken as a general rule that when sheep become broken-mouthed they begin to decline.

It will probably appear, when the subjects of breeding and grazing are discussed, that it will be the most profitable course to fatten the ewes when they are five, or at most, six years old, and supply their places with the most likely shearing-ewes. When a sheep gets much older than this, it begins to decline in its wool, and certainly loses much of its propensity to fatten; while, in the usual system of sheep husbandry, the principal profit consists in early and quick fattening.

Causes of which the farmer is utterly ignorant, or over which he has no control, will sometimes hasten the loss of the teeth. Mr. Price says that the teeth of "the sheep in Romney Marsh decay much sooner than in any other part of England*." Although this is stated with regard to his native and favourite breed of sheep, it is probably an incautious expression, and an accusation which the Romney Marsh flock do not deserve. One thing however is certain, that close feeding, causing additional exercise of the teeth, does wear them down; and that the sheep of the farmers who

* Page 84.

stock unusually and unseasonably hard, lose their teeth much sooner than others do *.

The natural age of sheep it is difficult to assign. They will usually live, and breed, and thrive tolerably well, until they are ten years old; but there are instances of their living and thriving to a much more protracted age. Lamerville speaks of a Spanish ram, thirteen years old, that died sound and got lambs in his thirteenth year †. Mr. Moore, of Winthorpe, had on his pastures in 1824 a ewe that yeaned a pair of lambs when she was a shearling, had two pairs yearly for fifteen years, and in the last two years produced single lambs ‡. Mr. Culley has "heard of particular sheep living to nearly twenty years old,—those which the mountain shepherds call *guide-sheep*, viz., old wethers kept on purpose to guide and direct the bleating flocks upon those unfrequented wilds §."

The molar teeth or grinders of the sheep are well adapted for lacerating, and reducing almost to a pulp, the grassy or more hardened fibres which compose a great proportion of the food of the animal. They are not only surrounded by enamel, but columns of it sink deep into their substance and rise above the upper surface of them. The faces of these teeth are cut into a number of deep grooves running across them, from without, inwards, and the projecting parts of the teeth of the one jaw are received into the depressed grooves of those of the other.

The faces of the molars being also slanting, in a direction from without, inwards in the lower jaw, and from within, outwards in the upper one, and the projecting edges of the enamel being exceedingly sharp, it is almost impossible that, in the lateral grinding motion of the lower jaw in the act of rumination, and the slow and careful manner in which it is performed, many of the fibres can escape, or if they do, there is an after provision for reducing them, which will, in the proper place, be described.

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## Chapter II.

**The antediluvian Sheep—The Offering of Abel—The Sheep probably not at first used for Food—The First Parents clothed with the Skins of Sheep—Later Improvements on this Species of Clothing—The Origin of the Nomadic Shepherds—The Discovery of Felting—Permitted to be used as Food—The wandering life of the ancient Patriarchs—Their Tents—Great numbers of Sheep and Cattle—The manner of life of the first Shepherds—The importance of Water for their Flocks—The old Wells—The labour of the Female in tending the Sheep and Drawing Water—Jacob and Laban—The first recorded Improvement in Sheep—The Origin of the White Fleece—Gradually spreads over the Western World—The Primitive Breed of Sheep horned—Characterized by Fatness about the Rump—The Fat-rumped Sheep of the present day—The Persian Sheep—Was there any single Original Breed of Sheep?—Ancient Sheep Husbandry—The Duties of the Shepherd—His Sufferings from Drought or Cold—His Danger from Wild Beasts—No Dogs to assist in the Management of the Sheep—His own influence over the Flock—Gives Names to all the Sheep—They know his voice, and follow him—The Origin of the Shepherd's Music—The Humanity of the Shepherd—His care of the Lambs—The plucking of the Wool—The invention of Sheep-shearing—The docility of the Sheep—The Festivities of the Season—Clothing the Sheep—Cotting—Weaving**

* Mr. Dillon, in his 'Travels in Spain in 1779,' says that "The teeth of the Spanish rams do not fall until the animal is eight years old; whereas the ewes, from the delicacy of their frame, or from other causes, lose theirs at five years."

† Lamerville on Sheep, p. 102. ‡ Farmer's Journal, May 3, 1824.

§ Culley on Live Stock, p. 212.

—The state of the Manufacture of Wool—Spinning—Embroidery—The Male only usually destroyed—Animal Food seldom indulged in—The favourite parts—The stalled Ox—The Milk of the Ewe—Its properties—Cheese and Butter made from it—The Cave of Polyphemus—Different processes of making Butter—The use of the Ewe's Milk in other Countries—England—Scotland—France—The Rochfort Cheese.

### THE ANTEDILUVIAN SHEEP.

Although there are few traces of the history of the sheep in the antediluvian age, yet mention is made of this animal very shortly after the expulsion of Adam from Paradise. It is said that "In the process of time," or, as it might have been rendered, "at the appointed time," showing that it was a custom which either the Divine command, or the good feeling and the gratitude of the earliest race of men, had established—"Cain brought of the first fruit of the ground an offering unto the Lord; and Abel, he also brought of the firstlings of his flock, and of the fat thereof."

Our first parents having been lately driven from Eden, where the earth spontaneously yielded them its fruits, and where, in a state of innocence, and living in a genial clime, the necessity of clothing was unfelt, Cain and Abel seem to have divided between them the future provision of the family: Abel became "a keeper of sheep, and Cain a tiller of the ground." One purpose for which these sheep were kept is sufficiently plain: instead of the insufficient and fragile covering of the fig-leaf, which they had contrived for themselves, it is recorded that "Unto Adam also and to his wife did the Lord God make coats of skins;" or he taught them to make coats of skins and clothed them.

### THE FLESH OF THE SHEEP NOT YET EATEN.

It is probable that the sheep was not then used for food. Ancient history is uniform in asserting, that in the golden or antediluvian age, the use of animal food was unknown*; and the language of Scripture, although not decisive, goes far to warrant the belief that the flesh of animals was not divinely sanctioned as the food of man until after the deluge. When Adam was first "put into the garden of Eden to dress it and to keep it," it is said unto him, "Of every tree of the garden thou mayst freely eat," save one. When he had offended and was expelled from Paradise, this is the sentence—"Cursed is the ground for thy sake. In sorrow shalt thou eat of it all the days of thy life, and thou shalt eat the *herb of the field;* in the sweat of thy face shalt thou eat *bread* †."

The language to Noah after the deluge is very different:—"The fear of you and the dread of you shall be upon every beast of the earth and upon every fowl of the air, upon all that moveth upon the earth, and upon all the fishes; into your hand are they delivered: every moving thing that liveth *shall be meat for you.* Even as the green herb (which was formerly appointed to be your food) have I now given you all things."

### THE MILK OF THE SHEEP EARLY USED.

As to the other mode in which the sheep has through every period of ancient history, and, in many countries, even to the present day, contributed to the support of man—namely, by the milk obtained from the female,

* See Ovid's Metamorphoses, lib. i. and xv.

"Not so the golden age—men fed on fruit,
Nor durst with bloody meals their hands pollute."

Josephus, whose history of the Jews, next to that given by the sacred historians, is most to be relied on, says expressly that "Abel brought the *milk* of his flock."

† Gen. iii. 17, 18, 19.

the sacrifice of Abel may convey more information than the reader at first imagines. The Hebrew word, which is here translated "fat," is in other places rendered "milk;" as in Gen. xviii. 8, where Abram is said to have taken butter and milk, and set it before his guests. Let it be thus rendered in the account of this offering—"Abel, he also brought of the firstlings of his flock, even of the milk thereof," or, "he brought the milk belonging to the first-born and best of his flock;" and it will appear that, even in so early a period of the world, the value of the sheep, as contributing both to the food and the clothing of man, was already understood, and that almost to the extent in which it is recognized at the present day by most of the shepherds of the eastern countries.

### THE EARLIEST DRESS.

The dress of the first pair was precisely that of the inhabitants of every country in an early period of civilization, or before civilization can scarcely be said to have commenced. The inhabitants of ancient Greece are described as clothed in the skins of the animals which they had either domesticated or killed in hunting *. The Britons, when their island was first visited by Cæsar, were either naked and their bodies fancifully painted, or clad in the skins of animals. Such is still, to a greater or less degree, the clothing of savages every where. At first the skins simply underwent the process of drying, and were then fastened round the neck of the wearer by a simple thorn, or a strip of leather; and they were worn with the wool within or without, accordingly as the weather was cold or hot, wet or dry. By degrees they were fitted to and disposed on various parts of the body, and cut into various forms, or selected of various colours, according to the fancy of the wearer. There was room for the exertion of considerable caprice and ingenuity here.

### THE EARLY IMPROVEMENT OF THE SHEEP.

Passing over the admixture, in process of time, of other skins of domesticated or tame animals, and confining the inquiry to those of the sheep alone, the commencement of the improvement of that animal, although perhaps proceeding very slowly, may be easily anticipated and believed. The colour would be an object of some importance. The skin would be valued according to its purity or brightness, or fashion (for early must have been the period of the world when that power had not begun to exert its influence); and an attempt would be made to perpetuate this colour in the flock. Individuals would be selected to breed from with an especial regard to this purpose, and the fundamental principles of breeding would be recognized and acted upon. The size of the skin would sometimes be a material object, and large sheep would be selected. The warmth of the clothing would be a more important affair, and thick and close, or long and shaggy fleeces would be sought after. The unpleasant sensation caused by the contact of coarse wool with the skin would lead to the choice of that of a fine and soft kind. A principle of economy, a desire to make this rude coat last as long as could be effected, would produce attention to the food and to the diseases of the animal, for it would soon be perceived that the adherence of the wool to the pelt was intimately connected with the health of the sheep. Many centuries would not pass without the discovery of

* ——————————"Uti
"Pellibus et spoliis corpus vestire ferarum."—Lucretius, lib. v. 951.
On the eastern coast of Tartary there is a tribe whose clothing is fish-skins, whence they derive their name *Yupi*, which signifies a "fish-skin."—Duhalde's History of China, vol. iv. p. 148.

some means of changing the natural colour of the fleece, and then the art of dyeing would commence. The improvement of the sheep may therefore be considered as having commenced even in these early times, and with this rude kind of clothing; although it would probably proceed slowly enough, and, after all, not be carried to any great extent.

### OTHER ANIMALS DOMESTICATED.

The account of the posterity of Cain advances the history of the sheep another and an important step. It is said that "Adah, the wife of Lamech," one of the descendants of Cain, "bare Jabal; he was the father of such as dwell in tents and have cattle *." The reader will observe here the use, for the first time, of the word *cattle*. It frequently occurs in the after-history of the Patriarchs. It is pleasing to connect with a descendant of Cain —Cain the fratricide—and as a proof that the curse did not rest for ever upon his offspring, the first mention of the domestication of other animals, almost as much connected as the sheep with the subsistence and the comfort of man.

### THE FIRST WANDERING SHEPHERDS.

Jabal was "the father of such as dwell in tents and have cattle;" or, as it should have been rendered, "Jabal was the father of those who dwell in tents *with* cattle." He commenced that wandering life in order to find pasture for his flocks which their increasing numbers probably now rendered necessary, which was afterwards pursued by Abraham and Isaac, and all the proprietors of numerous flocks in the East, and which the Arab and Tartarian shepherds continue to the present day. *Jabal was the first nomadic shepherd*, about five hundred years before the flood.

### THE FLEECE OF THE SHEEP MANUFACTURED INTO THE COVERING OF TENTS.

"Jabal was the father of such as dwell in TENTS." This is another extension of the use of the sheep: he furnished the antediluvians not merely with coverings for their bodies, but also for their moveable habitations. In what way this was managed the only authentic book of early record does not mention. The tents of the ancient shepherds, and even of those of modern times, are described as very differently constructed in different countries and among different tribes. They are spoken of by some authors as consisting of skins sewn together, and by others as made of cloth manufactured by the process of felting. In later times they are said to have been woven, the wool being spun and made into cloth by the wives and daughters of the inhabitants of these tents. Probably these were the three gradations.

### FELTING.

The skins of animals, whether domesticated or wild, were rudely sewn together in order to shelter the primitive Asiatic shepherds from the heat of the noonday sun, and from the intense cold of the night, each equally insupportable in that climate. It is, however, scarcely possible to suppose that sixteen hundred years (the interval between the creation and the deluge) could pass without the value and use of the wool, when detached from the pelt, being to a certain degree observed. Its property of matting together, and forming a compact mass on certain parts of the living animal, would be first taken notice of; and when these portions were separated from the fleece, curiosity or accident would discover that this process might

* Gen. iv. 20.

be extended to a greater or less degree by beating, or by pressure, and that the wool would form a soft and pliable and warm substance, evidently fitted for human clothing, and far more comfortable, and more easily applicable to the wants of the individual and of society, than the skins that had been previously used. The felting property of wool would thus be developed; and that rude species of manufacture, by means of which the fleece used to be converted into cloth, and is still so in some of the less civilized portions of society, would be invented and improved to a very considerable degree.

### THE FLESH OF THE SHEEP USED AS FOOD.

For nearly twelve hundred years longer, the early history of the Sheep can be traced in the Scriptures alone. The first passage that throws light upon it is the permission to use the flesh of animals as food, and which has already been hinted at. "Every moving thing that liveth shall be meat for you; even as the green herb," as I formerly gave you the green herb, "have I" now "given you all things*."

It does not, however, appear that, for a considerable period, full advantage was taken of this permission. The flesh of animals seems to have been first eaten at the periodical sacrifices that were offered to the Giver of all things. After that, animal food was considered as an occasional luxury, and as an indulgence not to be justified except on some particular occasions†. It was long before the generality of persons could be brought to feed on the animals that they had domesticated,—that they had been in the habit of daily seeing and tending, and from which they had derived so much advantage‡. The old custom of living on vegetables alone is retained in some parts of the East to the present day, and is considered by certain Indian castes as a religious duty.

The animal which is the subject of the present history never seems to have been generally used for human food. Many of the wandering tribes preferred the flesh of the horse and of the camel to that of the sheep§; and even at this day the latter is comparatively disliked in Spain ‖—a prejudice exists against it in America—in no country does it appear to have been so universally adopted and so much relished as in Great Britain, and even there, it will hereafter be seen, that the liking is but of recent growth.

The following passage is found in Pliny (Secundus)¶, and is thus translated by old Philemon Holland:—"Sheepe likewise are in great request

* Gen. ix. 3. † Wilson's Archæologia *in loc.*

‡ Many more than a thousand years after this, the following opinions were prevalent, and almost assumed the authority of laws, among the most civilized and luxurious people of the world. "No one was to kill an ox which laboured at the plough," (Ælian Var. Hist. lib. v. c. 14). "No one was to kill a lamb or an ox under one year old," (Athenæus, lib. i. and ix.; Eustathius in Iliad, &c.). And, honourable to the age and the country, "No one was to hurt any living creature," (Porphyr. de Abstinen.; Hieronim. in Jovin. lib. ii.) The use of animal food was slowly and never universally established.—See also Robinson's Archæologia Græca, pp. 118 and 496.

§ In an account of the Calmucs and Cossacs, drawn up by M. Polignac at the command of the reigning monarch in 1750, it is said of them,—"The usual food of these Tartars is horse-flesh. Bread and mutton are reserved for the rich and wealthy burghers that live in their towns without ever taking the field. Their clothing is sheep-skins. In winter they wear the wool next to them; but in summer, or when it rains, they have the wool on the outside."

‖ Dr. Parry, the earliest and the latest advocate of the Merinos, acknowledges that the carcass of the sheep "is an object of little or no value in Spain, and that, except with the poorest people, it is not considered fit for food."

¶ Lib. viii, c. 47.

both in regard they serve as sacrifices to appease the Gods, and also by reason of their fleece yielding so profitable a use: for even as men are beholden to the bœufe for their principal food and nourishment which they labour for, so they must acknowledge that they have their clothing and coverture for their bodies from the poore sheepe."

A quotation from an old English poet shall close this account of the use of the sheep as food:—

> "Poore beast that for defense of man at first created wast,
> And in thy swelling udder bearst the iuyce of dainty tast;
> That with thy fleece keeps off the cold that would our limbs assaille,
> And rather with thy lyfe than with thy death doest us availe."

It is somewhat singular that notwithstanding this seeming prejudice against the flesh of the sheep, all writers on diet have agreed in describing it as the most valuable of the articles of animal food. Pork may be more stimulating; beef, perhaps, more nutritious when the digestive powers are strong: but, while there is in mutton sufficient nutriment, there is also that degree of consistency and readiness of assimilation which renders it most congenial to the human stomach, most easy of digestion, and most contributable to health. The flesh of the ram is tough—it has an unpleasant flavour, and is scarcely eatable; the meat of the ewe, and especially if she is not cast until she is old, may be somewhat hard and deficient in juice, but a wether in his prime according to the breed, whether the present improved one that rarely lives beyond his second year, or a native of the heaths or the hills that does not arrive at perfection until he is four or five years old, will afford a species of food unequalled in its grateful taste and genuine wholesomeness. Of it almost alone can it be said, that it is our food in sickness as well as in health; its broth is the first thing that the invalid is permitted to taste, the first thing that he relishes, and is his natural preparation for a return to his common aliment*.

Although nothing can yet be asserted of the form and qualities of the primitive sheep, yet it is plain that from the moment of its being used for food its more rapid improvement must have commenced. If cultivated only for the wool, there would almost necessarily be that want of beauty and compactness, and profitableness of form, which in the case of the Merinos proved an insurmountable objection to the introduction, into a thickly populated country, of a sheep possessing the finest and the heaviest fleece, but failing in the production of animal food. If, on the other hand, the carcass occupied the whole of the attention of the shepherd, the wool would rapidly degenerate and become comparatively worthless. It is when the farmer has due regard to both of these essential properties of the sheep, that that animal can reach the degree of improvement of which nature has made it capable, and to which on British pastures it has arrived.

Lord Somerville has placed this in its proper point of view when he says that "sheep are bountiful animals to man, for, let us blunder as we will, they feed us, clothe us, and can hardly, under any bad management, be kept with loss:" and he adds, that "the breed of sheep, which on any given quantity of land will carry for a continuance the most wool as well as flesh, and both of the highest quality, is the breed to be preferred, or which has arrived nearest to perfection."

## DESCRIPTION OF THE ANCIENT PATRIARCHS.

Two hundred and sixty years now pass over before the mention of any thing occurs that has reference to the present inquiry; it is then (1921

* Brewster's Encyclopædia, art. ALIMENTS.

B.C.) recorded that Abram and Lot came from Ur of the Chaldees, and Abram pitched his tent on "a mountain on the east of Bethel*." Thence he journeyed into Egypt, and he is said to have had "sheep and oxen, and men servants and maid servants, and asses and camels†." Returning towards Palestine he is described as being "very rich in cattle, in silver, and in gold; and Lot also which went with Abram had flocks, and herds, and tents, and the land was not able to bear them that they might dwell together‡,"—there was not sufficient pasture for the numerous flocks of both; whence arose "strife between the herdmen of Abram's cattle and the herdmen of Lot's cattle§," and these relatives and friends separated from each other, Lot journeying towards Sodom, and Abram taking his course towards Canaan. After this Abram removed to the plain of Mamre, and there learning that his brother Lot had been attacked and made prisoner by some of the chieftains of that country, "he armed his trained servants," trained for war, "born in his own house, three hundred and eighteen, and pursued" the spoilers and smote them, and rescued his brother and all his property‖.

### THE PEREGRINATIONS OF THE ARABS.

These passages, written more than 3700 years ago, and which will be considered separately, present a singularly correct picture of the present mode of life of the Arabian and Tartar shepherds. Abraham and Lot are living in tents. The Chevalier d'Arvieux, who published an account of his travels in the East in the early part of the last century, and the fidelity of whose narrative has never been disputed, thus describes the Arabian shepherds:—"These Arabs have no other lodging but their tents, which they call houses; they are all black, of goat's-hair canvass, and are stretched out in such a manner that the rain easily runs off without ever going through them. Their whole families, and all that they have in the world, even to the stables, are there, particularly in the winter. The tent of the Emir is of the same stuff, and differs only from those of his subjects in bigness."

Abram pitched his tent on a mountain. D'Arvieux says that "the Arabs commonly encamp on the top of some little hills, where there are no trees to hinder them from discovering a great way off all that come and go, that they may not be surprised, having nothing else to fear."

Abram is described by the sacred history as shifting his residence from place to place. D'Arvieux says that "the Arabs set themselves down wherever they find springs of water, or rivulets in the valleys, and pasture for the subsistence of their cattle, and then decamp, as soon as that is gone, and go and post themselves in another place every fortnight, or at most every month. They live all the summer upon these hills, always advancing towards the north; and when winter begins to come in, they go by degrees towards the south, as far as Cæsarea of Palestine, and on the outside of the mountains of Carmel."

A traveller thus describes the march of the modern Arabs:—"Their wandering life, without ambition, brings to the mind of the traveller that of the ancient patriarchs. Nothing is more interesting than their manner of changing their abode. Numerous flocks, which precede the caravan, express, by their bleating, their joy at returning to their former pastures. Some beasts of burden, guided by the young men, bear the little ones just dropped and not able to travel. Then come the camels, carrying the baggage

* Gen. xii. 8. † Gen. xii. 16. ‡ Gen. xiii. 2, 5, 6.
§ Gen. xiii. 7. ‖ Gen. xiv. 14, 16.

and the old and sick women. The rest go on foot, carrying their infants at their backs, or in their arms; and the men, mounted on their horses, armed with lances, ride around and bring up the march of the cattle which loiter behind, browsing as they slowly move on. In this manner they journey, and find their homes, their hearths, and their country in every place*."

The weary Arabs roam from plain to plain,
Guiding the languid herd in quest of food,
And shift their little home's uncertain scene,
With frequent farewell: strangers, pilgrims all,
As were their fathers†.

## NUMEROUS FLOCKS.

The sacred history goes on to state that "the flocks and herds of Abraham and Lot were so great that the land was not able to bear them." There was not sufficient pasture for the support of their united flocks. The Scriptures often speak of the immense flocks of sheep with which Palestine abounded. Job had 14,000 sheep, besides oxen and camels. The sheep always constituted by far the most numerous part of the shepherd's possessions. When 12,000 of the Israelites made an incursion into Midian, they brought away, besides other spoils, three score and twelve thousand beeves, and 675,000 sheep ‡. When the tribes of Reuben and Gad made war with the Hagarites, they obtained as a booty 250,000 sheep §. The king of Moab rendered a yearly tribute of 200,000 sheep; and Solomon offered 120,000 sheep at the dedication of the Temple ||.

There are many circumstances which will readily account for these numerous flocks of sheep. They were the chief possession,—the almost only riches of the people: comparatively few of them were destroyed, for their flesh was rarely eaten, except on solemn sacrifices, or occasions of peculiar rejoicing; and there is reason to believe that the ewes had lambs twice in the year. The Jewish writers frequently speak of the first and second yeanings, referring the former to the month Nisan, corresponding to the March of the modern calendar; and the other to the month Tissi, answering to September. The lambs of the two seasons were distinguished

* "After this horde I met with a smaller party, consisting of about a dozen families: they were approaching a beautiful little hollow, surrounded on three sides by hills, and which they seemed to have chosen as the place of their encampment. The sheik was the only one of the whole who rode. The rest of the men walked, as did most of the women. The boys drove the flocks of sheep and goats, and the little children the young lambs; the kids and the poultry were carried in panniers or baskets across the camels' backs. The tents, the cooking utensils, and the provisions and furniture were likewise laden upon these useful animals. As the camels halted every minute to pull a handful of leaves from the bushes, the progress of their march was very slow; but the patience of all seemed quite in harmony with the tardy movement of the camels, and it was evidently a matter of indifference to every one of the group whether they halted at noon or at sunset, for an hour was time enough to prepare their shelter for the night." —Buckingham's Travels in Palestine, p. 324.

"It was entertaining enough to see the horde of Arabs decamp. First went the sheep and goats in regular divisions, then followed the camels and asses, loaded with the tents, furniture, and kitchen utensils. These were followed by the old men and the women, and the boys and girls on foot. The children that could not walk were carried on the backs of the young women, and the boys and girls; and the smallest of the lambs and kids were carried under the arms of the children. The procession was closed by the chief of the tribe mounted on the very best horse, and surrounded by the heads of each family all on horses, with many servants on foot."—Parson's Travels from Aleppo to Bagdad, p. 109.

† Dyer's "Fleece," Book I.

‡ Numbers xxxi. 32, 33. § II. Chron. vii. 5. || I. Chron. v. 21.

by different names descriptive of their supposed qualities: the first were called *keshorim*, or *bound*, on account of their stronger-built or more compact frame; the second *ætophim*, or *deficient*, because they were feebler and of comparatively less value*.

These numerous flocks, however, were not confined to ancient times. Sir John Chardin had the opportunity of seeing a clan of Turcoman shepherds in their march about two days' distance from Aleppo. There were 400,000 beasts of carriage,—as camels, horses, oxen, cows, and asses; and there were more than 3,000,000 of sheep and goats. Dr. Shaw states that several Arabian tribes who can bring no more than 300 or 400 horses into the field, are possessed of more than as many thousand camels and oxen, and treble the number of sheep and goats †.

### HOSPITALITY.

A circumstance, apparently trivial, is soon after recorded, and only mentioned as showing the minute accuracy with which the historian has depicted this primitive shepherd. "As he sat in the tent door in the heat of the day, he saw three strangers approaching ‡." The following passage is a sufficient comment. It was the hottest part of the day of which the traveller speaks. "We had in view several fine bays, and a plain full of booths, with the Turcomans sitting by the doors under sheds resembling porticoes, or made by shady trees, surrounded by flocks of goats §." To entertain these travellers, Abram "took butter and milk, and the calf which he had dressed ‖," and set it before them. It is merely observed at present, that this is the first time that any particular kind of animal food is spoken of; and that the word translated *butter* is sometimes rendered *fat*, and, more frequently, *cheese*. The manufacture of cheese was indicated by the natural curdling of the milk,—and the mention of it occurs in profane history many centuries before butter was known, or at least spoken of. Both of them were composed principally, or almost entirely, of ewes' and goats' milk, mixed together except a small quantity, used only as a delicacy, and made from the milk of kine. It will hereafter be shown from other passages, that the milk which was presented to the strangers was ewes' milk; and which, in later times, was changed for that of camels ¶.

* There are several passages of Scripture which lead to the supposition that the Eastern sheep often produced two, and sometimes more than two lambs at a birth.—Ps. cxliv. 13; Solomon's Song, iv. 2. Sir Thomas Browne observes, in his Miscellaneous Tracts, "that the sheep of Palestine must not be judged of by ours, for they were abundantly more prolific." Bochart has proved this fact, vol. ii. p. 432, 510. See also Burder's Oriental Literature, vol. ii. p. 56.

† Shaw's Travels, ii. p. 125.

‡ Gen. xviii. 1, 2.

§ Chandler's Travels in Asia Minor, p. 180.

‖ Gen. xviii. 8.

¶ Burckhardt affords an excellent commentary on this. "*Ayesh* (flour and sour camel's milk) is the usual and universal dish with the Aeneses, and even the richest sheik would think it a shame for his wife to dress any other dish merely to please his own palate. For a common guest bread is boiled and served up with the ayesh; but for a guest of rank a kid or a lamb is killed. They boil it with *bourgal* (wheat boiled in some leaven and then dried in the sun) and serve it in a wooden dish, round the edges of which the meat is arranged. A wooden bowl containing the melted grease of the animal (often called butter, or camel's grease, and which is kept in goat skins, and used as butter) is pressed down in the midst of the bourgal, and every morsel is dipped into the grease before it is swallowed."—Page 35.

Buckingham also, in his 'Notes on Palestine,' well illustrates the conduct of Abram to these strangers. "A poor man, if he is hospitable, always kills a lamb when a stranger arrives, gives coffee to all the guests present, holds his bag of tobacco always ready to supply the pipes of his friends, and sacrifices his last penny to honour his guest,

## WELLS.

In the deserts of Arabia, and even in the plains of Judea, water was essential, not only to the comfort and thriving of the flock, but to its very existence; and one of the most important duties of the shepherd was to enable the sheep occasionally to quench their thirst. It was rare that the flowing stream was met with in these sandy regions; natural pools of water were almost as unfrequent, and a drought of no long duration would cause them to disappear *. To prevent disappointments of this kind, the shepherds, with immense labour, dug wells at their usual resting-places, and at other spots in the intermediate distance;

> "The ancient wells, deep sunk with toil immense,
> Toil of the Patriarchs, with sublime intent,
> Themselves and long posterity to serve †."

These, however, in process of time, decayed, or were choked with sand, or they were wilfully filled by a vindictive enemy; or the struggle to procure water from them, between the herdsmen belonging to different masters, was productive of quarrels and bloodshed. To prevent these evils, certain usages were gradually established, and acknowledged and respected by all the neighbouring herdsmen, except those who were perfectly lawless.

It was because Abraham had suffered from some of these inconveniences, and particularly the petty warfare which existed between his herdsmen and those of Abimelech, king of the Philistines, that the following transaction took place. Abraham, after presenting Abimelech with some sheep and oxen, in token of the cessation of their quarrel, "set seven ewe-lambs of the flock by themselves. And Abimelech said unto Abraham, What mean these seven ewe-lambs which thou hast set by themselves? And he said, For these seven ewe-lambs shalt thou take of my hand, that they may be a witness unto me that I have digged this well ‡."

Abraham effected a regular and freehold purchase of the well and the ground in which it was dug at the price of these seven ewe-lambs. They were *the money* which he paid for this spot of ground; or "they were that commodity of known value and general demand which stood in the stead of money," proving how universally they had spread, and how generally their value was acknowledged §.

or relieve those who want. In his common living the richest sheik does not differ from the meanest of his tribe. They eat every day of the same dish, and never partake of any luxury, except on the arrival of a stranger, when the tent of the host is open to all his friends."—Page 41.

* M. de Brisson, in the History of his Captivity among the Arabs, describes the drought which occasionally prevails. "The end of the year was now approaching, and a single drop of rain had not yet fallen. The plains and the valleys were entirely burnt up; nothing remained for the nourishment of the flocks, and the month of December had arrived, when the rains generally ceased until the next October. The desolation was universal, when an Arab from a distant part of the country came to inform us that abundant showers had refreshed the earth in some remote districts. Upon the news, joy succeeded to fear and grief—every one struck his tent, and set out for the regions that had been lately watered."—p. 37.

Even in the more temperate clime of Britain, sheep have often severely suffered from want of water. The summer of 1803 was unusually sultry and dry. "A flock of sheep at Pevensey, consisting of 300, being driven to a pond, after long thirst, drank so immoderately that more than a hundred of them died."—Annual Register, 1803.

† Dyer's Fleece, Book I.

‡ Gen. xxi. 27—31.

§ "Wealth used to be estimated by the number and quality of the cattle. They were the principal instruments of commerce. Thus we read in Homer of a cauldron being worth twenty sheep, and a goblet worth twelve lambs, &c. These animals were the means by which exchange or commerce was originally carried on. The proof of this is convincing enough, as well as very singular. The word which signifies the exchange of

### JACOB AND LABAN.

A hundred years elapse before the scriptural history of the sheep is resumed. Jacob had escaped from the justly merited anger of his brother Esau, and had travelled eastward until he arrived at Haran*, where his uncle Laban had at that time pitched his tents. As he halted by a covered well, Rachel, the younger daughter of Laban, came to water her father's sheep. She is the first shepherdess of whom mention is made in ancient history, and her name, which signified a sheep, was characteristic of her occupation.

### THE FLOCKS TENDED BY WOMEN.

This meeting of the cousins presents another picture of these early times. Rachel, the daughter of a man of some substance in that part of the country, tends her father's flock †; and Jacob, the son of a shepherd-prince, rolls away the stone from the well, and afterwards becomes servant to her father for her sake. It is precisely in keeping with the accounts of profane authors some centuries afterwards, when the daughters of nobles and princes are represented as employed at home in weaving garments for the family, or looking after the flocks abroad, and feeding the horses, and fetching water from the fountains.

### THE FIRST GREAT IMPROVEMENT OF THE SHEEP.

"Jacob served Laban seven years for the sake of Rachel, and they seemed to him but a few days, for the love he had to her;" and then, being deceived by her father, he served for her yet another seven long years: at the expiration of that time, Laban offering him no wages, he was naturally anxious to return to his father. Laban, however, who was conscious that much of the prosperity that had lately attended him was attributable to the skilful and faithful service of his son-in-law, entreated him to remain, and Jacob consented on certain strange conditions. The wording of the common translation is not a little obscure ‡; but the meaning, as understood by the parties, was this: that in future, the speckled or ring-streaked sheep and goats—exceptions to the general colour, a brown or dingy black—the sportings rather than the regular productions of nature—should be considered as the wages of Jacob. These could hitherto have been very few, or the selfish and avaricious father-in-law would not have consented to the

one kind of goods for another is derived from the Greek word for a *lamb*, ἀρνυσσαι, from αρνος. A wealthy person is called 'a man of many lambs,' and two rival brothers are represented by Hesiod as fighting about the 'sheep,' that is, the property of their father."—Hunter's Sacred Biography, *Abraham.*

* Gen. xxix. 1.

† In the descriptions already given of the marches of the horde, they have been seen toiling on foot with their children at their backs, and the younger girls taking the principal share in carrying the infants or the lambs. Burckhardt shall illustrate their employment when the tribe has arrived at its resting-place: "Among the Arabs of Sinai it is an established rule that neither the men nor the boys should ever drive the cattle to the pasture. A boy would feel insulted if any one were to say, 'Go and drive your father's sheep to pasture;' these words would in his opinion signify, 'You are no better than a girl.' This is the exclusive duty of the unmarried girls of the camp, who perform it by turns. Thus early accustomed to such fatiguing duties, the Sinai women are as hardy as the men. I have seen these females roaming bare-footed over sharp rocks, where I, well shod, could with difficulty step along. During the whole day they continue exposed to the sun, carefully watching the sheep, for they are sure to be severely beaten by their father should any be lost."—Notes on the Bedouins. Their brothers or their fathers had indeed the grace to relieve them from their post when the day was passed, and the wild beasts of those uncultivated regions began to be in motion.

‡ Gen. xxx. 32.

proposal. The bargain was struck, and all the parti-coloured cattle were separated from the rest, and driven away to a distance of three days' journey, and put under the care of Laban's sons, so that there could be no imposition or dishonesty; and the sheep of a uniform colour were left with Jacob.

He had probably witnessed the power of imagination at the moment of the female's conception, and had thought that he might turn this, and not dishonestly, to his advantage, for the compact between them was sufficiently plain: "Jacob therefore took him rods of green poplar, and of the hazel and chestnut-tree, and pilled white strakes in them, and made the white appear which was in the rods, and he set the rods which he had pilled before the flocks in the gutters in the watering-troughs, when" (at the time of the unrolling of the stone, a work of labour, and therefore done as seldom as possible) "all the flocks, male and female, came to drink *;" and they generally coupled before the watering-troughs, and with these straked and pilled rods before them. When by these means some speckled or ring-straked lambs had dropped, he placed them in the sight of the other ewes—"he set the faces of the flocks towards the ring-straked," in order that they might produce the like.

It was only when the stronger sheep, those of the first yeaning, were in season, that he resorted to this expedient; the autumnal and weaker cattle were suffered to take their course. The consequence was, that either from the power of imagination in the mother, carried to an extent the like of which is certainly not seen at the present day, or from some superior over-ruling agency, the flock generally "brought forth cattle, ring-straked, speckled, and spotted." The whole story would induce the belief that some superior power aided the ingenuity of the servant, and rewarded his fourteen years' fidelity to an ungenerous and avaricious master †.

Laban was, as might be expected, very much dissatisfied, and altered, unjustly altered, the wages of his servant. He limited this change of colour to one kind alone. First he said that the speckled only should belong to Jacob. Perhaps he might have seen or heard of the pilled rods, and imagined that he should thus thwart the stratagem of his servant; but either speckled rods were substituted for those that had been pilled in the form of rings, or this superior agency continued to influence the breeding of the cattle—the lambs were all speckled. Again he affirmed that the bargain extended to the ring-straked alone, and the lambs then were dropped ring-straked; and so in process of time "the cattle were taken away from Laban and given to him, and the man increased exceedingly, and had much cattle, and maid-servants, and man-servants, and camels and asses ‡." During the whole transaction, although Jacob did not immediately separate the parti-coloured lambs from their mothers, for a reason that has just been hinted at, yet he continued to breed from those of one uniform colour.

### THE PROGRESS OF THE IMPROVEMENT.

This is the first intelligence which the Scriptures afford of the kind of sheep in these early times, or at least of those of which these flocks were composed: they were of one uniform colour, brown or dingy black, and the exceptions

* Gen. xxx. 37, 38.

† Michaelis observes on this passage, that "even in later times a similar method is adopted in order to obtain a similar result, something white being placed in the water-troughs before the sheep, or white cloths hung up in the fold; and even the water-troughs have been made of perfectly white stone, in order that white lambs might be produced." —*In loc.*

‡ Gen. xxxi. 8, 9, and xxx. 43.

were accidental and few in number. From the experiment or policy of Jacob, sheep of a new colour arose: they formed his numerous flock when he quitted the service of Laban; some of them afterwards mingled with the herds of Esau; they were probably continued among the descendants of Jacob, and the better appearance of the fleece, and the more varied and useful purposes to which it might be devoted, would lead to a selection from those that had the most white about them, until at length the fleece was purely white. It had become so in the time of David, who likens it to snow*; and Solomon speaks of the teeth of his mistress, as resembling a flock of sheep just come up from the washing†.

Mr. Luccock, whose researches into everything connected with wool are exceedingly valuable, clearly traces the present colour of the fleece to these proceedings of Jacob. He says that "this new variety of flocks soon established itself in the country where it was produced, and gradually diffused itself southward as far as the desert of Arabia, so that in the space of 300 (600) years its whiteness had become proverbial‡."

Some of the best principles of breeding must have been steadily and long pursued before this could have been effected; and probably in this, as in many other particulars, the ancients have not been far exceeded by the moderns in scientific and useful pursuits.

In the desert, where the numbers of the inhabitants were fewer, and their association with each other less frequent, the change was more slowly effected, or rather, has not been perfectly accomplished at the present day. The Arabs are true to the customs and prejudices of their ancestors more than 2000 years ago.

Mr. Luccock states, that "this alteration in the colour of wool evidently took the line of the richest soils, and spread its influence more readily through countries where the arts of husbandry had made the greatest progress, and but seldom passed their boundaries. From Persia, descending the Euphrates, and passing over the richer countries of Syria, it reached the borders of the Nile §." In this direction we are enabled satisfactorily to trace it, when, some centuries afterwards, the records of general history are joined to those of the Scriptures.

Northward, too, it began to spread; it ascended on either bank of the Euphrates, until it arrived at those of the Phasis, and diffused itself over the fertile country that lay at the feet of the mountains of Colchis, now Mingrelia and Georgia. There it seems peculiarly to have established itself, and, more than five centuries afterwards, its reputation had reached Greece. The leading men of the infant states of Greece united together, and, under some false or frivolous pretext, invaded Colchis, defeated and slew its king, and carried away the Golden Fleece. This was a prize not valuable, as some have feigned, on account of the particles of gold which, brought down by the torrents from Mount Caucasus towards the banks of the Euxine, were collected in the fleeces of sheep that were sunk in the streams in order to receive them ||, but from its own intrinsic excellence; and it has ever been, and will continue to be, a mine of gold to every country in which it is found, and its worth duly estimated.

The foundation of the splendour of the Grecian republics was laid by the celebrated Argonautic expedition; and in the course of this treatise, the progress and the beneficial results of the breeding of sheep and the manufacture of wool will be traced through many a country in the eastern

* Psalm cxlvii. 16. † Solomon's Song, iv. 2. ‡ Essay on Wool, p. 30.
§ Ib. p. 31.
|| Strabo, lib. xii. p. 199. Appian says, that Pompey, after the defeat of Mithridates, was an eye-witness of this fact.

and western worlds. In the meantime the memory of Jacob will be respected, not only from its connexion with sacred story, but because he was the first recorded improver of the sheep, and his improvement has survived the wreck of ages, and will never be surpassed. The superior cheerfulness which sheep and goats with white fleeces communicated to rural scenery, the cleanliness which wool of that description was calculated to promote when used as an article of furniture or of dress, and, above all, the greater variety and vividness of the artificial tints with which it might be imbued, conspired from the beginning, to render it more valuable, and, in every age, more sedulously cultivated than that of a dark or black hue.

Nature, however, although controlled, cannot be perfectly subdued. In some justly esteemed breeds of sheep we see traces of their original descent. Although, on the southern downs, that which was most valuable in the improvement of colour is retained, yet the muzzle and the legs betray the character of the early progenitors. In the Norfolks this is more decidedly seen; and now and then a perfectly black sheep betrays, in a manner not to be mistaken, the native hue, and the still lurking primitive tendency. Even where the fleece has, by diligent cultivation, been brought to the purest white, a dusky or a black lamb will occasionally display the colour, if not the other lineaments of the first parents.

The master and the servant, the father and the son-in-law, could not long remain together while the prosperity of the one was daily increasing, and the sources of wealth proportionably diminishing with the other; and accordingly it is said, that "Jacob beheld the countenance of Laban, and behold, it was not toward him as before:" and fearing, from the character of the man, and the too frequent practices of the times, that treachery or violence would soon be resorted to, he took advantage of Laban's absence, and fled towards his native land. The news was quickly conveyed to the father-in-law, who pursued the fugitive, and overtook him before he could reach the tents of Isaac. The explanation which took place throws still further light on the management of the sheep in those days.

After this the Bible contains only incidental mention of the sheep, its produce, and the treatment to which it was subjected. Patches of information scattered in various parts of the volume must be compared together, in order to obtain any satisfactory notion of the true character of the husbandry of the times. It will therefore be advantageous no longer to follow precisely the order of events, but to bring into one point of view the information which the Scriptures afford, connecting with this the few gleanings that can be collected from profane history, the earliest authentic records of which do not, however, commence until many centuries after the time of Jacob.

## THE ORIGINAL BREED HORNED.

The primitive breed was certainly *horned*, and those horns were of considerable size. When Abraham, in obedience to the Divine command, was about to sacrifice his son Isaac, his arm was arrested by a voice from heaven, "and he lifted up his eyes and looked, and behold, behind him a ram caught in a thicket by his horns *." The trumpets used in war were made of rams' horns †. The polled sheep were probably an accidental variety; and when first occurring, cultivated partly for their singularity, and more for their utility, whether with reference to the additional closeness of folding of which they were capable, or the fewer accidents that were likely to occur, or, most of all, from the superior docility and quietness of those

* Gen. xxii. 13. † Joshua vi. 6.

to whom nature had not given these weapons of offence, and of the use of which all animals soon become too conscious. There is not, however, a polled breed of the present day in which lambs are not occasionally dropped with the rudiments of horns: some of these horns grow to their full size, and others are curiously attached to the skin alone, and either hang loosely down, or drop off.

### THE ORIGINAL BREED.

From very early times two breeds of sheep have inhabited the countries over which the patriarchal shepherds roamed, and have spread themselves through the neighbouring districts. One has, as its principal characteristic, a lengthened tail, with an accumulation of fat around the superior part of it. These sheep have been found in Arabia and Syria, but most numerous in the interior, and in the southern part of Africa; and constituting the only native breed of these latter regions. The others have an accumulation of fat commencing at the posterior part of the loins, swelling gradually into a considerable mass towards the rump, and presenting behind two enlargements of a more or less globular form. This kind of sheep is scarcely known in Africa, but it covers both the north and the south of Asia; it prevails far more than the other in Palestine; it reaches even to the interior, and the northern part of Russia; and it is the kind of sheep of which the flocks of the Kalmucks and the Turcomans, and indeed of almost all the wandering hordes of shepherds are, to the present day, composed.

[*Fat-rumped Sheep.*]

The reader is here presented with a cut of it as it exists at the present day in the north-eastern part of Europe, through the whole of the temperate regions of Asia, and to a greater or less degree from the Baltic Sea to the North Pacific Ocean*. It is purest in the deserts of Great Tartary, and influenced in its form only by pasturage, soil, and climate; no other variety being near to contaminate its blood. The following is Dr. Anderson's account of this breed; not so precise, indeed, as could be wished, but sufficiently satisfactory.

* See Pallas's Travels in Russia, and particularly Anderson on the Russian Sheep, p. 26.

"The flocks of all the Tartar hordes resemble one another, by having a large yellowish muzzle, the under jaw often projecting beyond the upper; by long hanging ears, and by the horns of the adult ram being large, spiral, wrinkled, angular, or bent in a lunar form. They have slender legs in proportion to their bodies, a high chest, large hanging testicles, and tolerably fine wool mixed with hair. The body of the ram, and sometimes of the ewe, swells gradually with fat towards the posteriors, where a solid mass of fat is formed on the rump, and falls over the anus in place of a tail, divided into two hemispheres, which take the form of the hips, with a little button of a tail in the middle to be felt with the finger."

The admirers of some of the improved breeds of sheep will find great fault with the large and heavy head; the comparatively thin neck, and especially at the base, where it proceeds from the chest; the depth and want of substance from the withers to the elbow; the deficiency of brisket, its place being supplied by a kind of dewlap; the want of depth immediately behind the elbow; the tendency to belly posteriorly; the length of the legs; the gauntness and muscularity compared with the roundness and compactness of some modern breeds: but it cannot be denied, that, considering it as belonging to the wandering shepherds, as traversing a vast extent of country, and subject to want and to drought, and to the vicissitudes of the seasons, it is not badly adapted to the situation in which it is found, and there are evident capabilities of improvement, when chance, or the progress of civilization, may give opportunity for its development.

### THE PRESENT TARTARIAN SHEEP.

The flocks of all the Tartar hordes have much resemblance to each other; but climate, soil, &c., produce some small difference in them, whether reared by the Tartars, or by the Russians, in the western deserts of Great Tartary, from the river Volga to the Irtish and the Altaic chain of mountains. In all that tract of country the pasturage abounds with acrid and liliacious plants in spring; while in summer, at least in the open spots where sheep delight to feed, beside the common grasses, bitter and aromatic plants, wormwood, camphorosna, and many species of saltwort abounding in juices and salts are also found.

These sheep, liberally fed at first with the mother's milk, and afterwards traversing a rapid succession of saline and abundant pasture, attain a very considerable size. They often weigh more than 200 lbs., and may be considered as the largest of the unimproved sheep; of which weight the soft oily fat alone that forms on the rump amounts to from 20 to 40 lbs. * The *Uropygium*, or fat rump, which is made up of this oily species of fat, is so large as to incommode the animal in walking; but when the same sheep are carried into the interior parts of Russia, the tail loses half its size and weight, nay sometimes more than that, from a change in their food and mode of life †.

On the banks of the Volga below Lamara these saline pastures are

* The following is a description of one of these *Steatopyga*, or fat-rumped Kirguise rams, and that not of the largest size:—"*Head* rather less than many others of the same variety, and all black, even to the horns. *Ears* pendent and black, except the outer rim, which was spotted with white, as were the legs. *Throat* covered with greyish hair, the rest of the animal white. *Horns* spiral. *Uropygium* (fat-rump) very large, and divided into two hemispheres. *Anus* filled with fat, or rather stuffed with it in all parts. *Scrotum* covered with hair. *Prepuce* large. *Wool* coarse, and some inches long on the back, sides, and extremities; while it is mixed every where with hair.

"Total weight of the ram before cut up or skinned, 193 lbs.; the fat of the uropygium and anus 38 lbs."—Anderson, p. 31.

† Anderson, p. 31.

wanting: the snow likewise lies deep during the greater part of the winter, often causing a destructive scarcity of food among those who make no provision for a future day. The same kind of sheep prevail there; but they are diminished in size, and the fat rump is more than proportionably lessened, and even the horns are frequently wanting. On the Janisey they are considerably less. In other parts of these Tartarian regions, where the pasture is abundant but there is no saline impregnation, sheep of a size occasionally exceeding that of the Kirguise are found; but the excrescence on the rump is much smaller, and rarely greater than that which is found on the corresponding parts of some of the improved British breeds when fatted to excess.

A very intelligent writer gives a similar description of the Kerguise, or Kerguise and Kalmuckian sheep. In the mountainous districts "they are higher than a new-born calf, and so strong and heavy that the full grown ones weigh between four and five poods. In shape they resemble the Indian sheep. They have the arched front of the old battering-ram, prominent under lips and large pendulous ears. Instead of a tail, they have a monstrous round of fat like a cushion, weighing 30 or 40 lbs., and yielding between 20 and 30 lbs. of tallow. Their wool is coarse, entangled together, and strongly mixed with hair. The rams are universally, and the wethers generally, horned; and some, like the Icelandic, have four, five, or six horns. During the whole winter they seek their fodder under the snow, without losing their condition by it. To this the shortness of the season much contributes, as well as the circumstance that the snow passes away more rapidly on the salt parts of the steeps; and all animals are fattened by feeding on the vegetables of a saline soil.

"So rich is the country with sheep, that common Tartars often possess a thousand, and some of the richer ones more than fifty thousand.

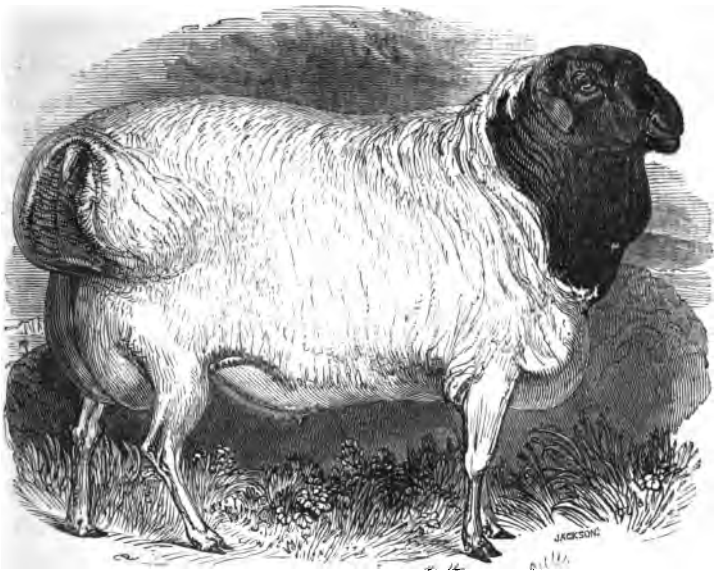
"The Kalmuckian sheep differ from the Kirguise in their smaller size, less curved forehead, lesser although pendulous ears, less hairy wool, and being seldom horned. They are sadly neglected; indeed it is in a manner impossible to compel the Kalmucks to be good agriculturists *."

In the neighbourhood of Caucasus and Taurida, the hind-quarters of the sheep are salted as hams, and sent in great quantities to the northern provinces of Turkey. In the south-east of European Russia, and particularly in the government of Kazan, the wool of the sheep is particularly fine, and almost without any mixture of hair; but, generally speaking, it is coarse, and used only for inferior cloths; but the greater part of the cloths of this description used in Russia are imported. Much of this coarse Russian wool is imported. It is used in the manufacture of carpets, and the list of some cloths is made of it. The present mode of dressing cloths cannot be fully effected except the list is made considerably stronger than the body of the cloth. Low foreign wools are used for this purpose, because they are stronger, and can be procured at less price. Some very fine wool is imported from the south of Russia, and especially from the port of Odessa. The Russian wool is usually very clean and white. It probably is not washed on the back of the animal, but after it is shorn.

### THE POLLED FAT-RUMPED SHEEP.

A breed of fat-rumped sheep prevails in Persia. Anthony Jenkinson, in his Travels from Moscow to Khorasan, in the 16th century, thus speaks of them:—"The people have great store of cattel, as camels, horses, and sheep, both tame and wild. Their sheep are of great stature, with large buttocks weighing 60 or 80 lbs. in weight †.

* Agricultural Magazine, Dec., 1804. † Hackluyt's Collection, vol. i. p. 329.




[*The Persian Ram.*]

This cut contains the portrait of a Persian ram, belonging to the Zoological Society of London. It is not of the enormous size just spoken of, but gives a fair representation of the hornless, fat-rumped sheep of the east. The wool, although short, and somewhat curled, is coarse and hairy. This is a fault, however, which, with due care, might probably be removed in the course of a few generations. The level back and belly, the rounded carcass, and the light small leg, would induce the easy belief that from such animal our down and mountain sheep might originally have sprung. There is no irreconcileable difference of form: the only peculiarity is the enlarged buttock. Difference of pasture and of climate might materially effect that; or, what is much more probable, skilful selection and breeding might convert the disposition to accumulate fat on a particular part into a tendency to acquire general good condition*.

The broad or fat-*tailed* sheep are probably varieties of the fat-rumped ones, and will be presently described.

Are there any passages of Scripture which indicate that this breed of sheep, which now mostly prevails in Palestine, and forms the flock of the wandering shepherd there, is the same with that of which the sacred historians often speak? There are passages which seem to have a singular and satisfactory reference to these distinguishing characters of the eastern sheep of the present day.

* Fraser, in his Travels through Khorassan, gives a very sufficient reason why the Persian sheep-owner should be somewhat careless about the improvement of his flock, at least in the neighbourhood of royalty. He says—"The Persian king is a good shot, and delights to shoot at a mark; but he also loves to make his amusement profitable. The mark commonly made use of is a live sheep, near which stands a *furosh* ready to tell the success of the shot, and to dispatch the animal, if only wounded. When his majesty is ready to shoot, he challenges his courtiers about him to bet with him about the shot, and it would be the height of rudeness and impolicy to refuse. The king's game, however, is sure; for whether he strikes the animal or not, the furosh, who has had his lesson, and whose property the carcass is to be, rushes on it the moment the shot comes, with a 'Mash Allah!' (bravo), knocks it down, and cuts its throat; and no one, of course, can question the author of its fate. These sheep are always the property of some villager or farmer near the place, and are never paid for by his majesty."

### FURTHER PROOF OF THE PATRIARCHAL BREED.

The Israelites, at first in conformity with the custom of their forefathers, and afterwards by Divine command, offered in sacrifice different animals, as an acknowledgment of gratitude to that Being from whom they derived every good. Sometimes the whole animal was burned; at other times the fat, or the fattest part, was selected, whether because it was the most delicate and valuable part of the animal *, or that it would most readily take fire, and diffuse itself in the air, and rise a grateful offering to Him who was supposed to inhabit the heavens. The book of Leviticus arranges the form and ceremony which was to accompany these offerings. First, it describes the manner in which they were consecrated to their office who were to conduct and preside over these sacrifices. Aaron was brought before the altar, and the "ram of consecration" was led out and slain. And Moses "took the fat, and *the rump*, and all the fat that was upon the inwards," and "burnt them on the altar upon the burnt-offering †." Aaron, after his consecration, makes the first offerings for himself and the people; and when every thing is prepared, the burnt-offering is placed upon the altar, and Aaron "did wash," cleanse from blood, "the inwards and *the legs*, and burnt them upon the burnt-offering upon the altar ‡."

* The substance which was accumulated on the rumps of these sheep, and formed the broad part of the tail in other sheep, consisted more of the nature of marrow than of fat, and was esteemed one of the greatest delicacies that could be presented at the table. Its almost semi-fluid character is very evident in the Persian sheep belonging to the Zoological Society of London.

† Leviticus viii. 25, 28.

‡ Leviticus ix. 14. The question whether the different varieties of the same species of animal have been produced by accidental deviations from one original parent breed, or whether there may not have been, from the beginning, several varieties of the same species, endowed with different qualities, and instincts, and propensities, adapting them to the situation in which they are found, is one of considerable interest to the zoologist, but with which the breeder of any species of animal has little to do. It is also a question difficult to solve—it is one that does not admit of demonstrative proof either the one way or the other, and on which it does not become the candid inquirer to speak positively and with arrogance.

These observations are induced by the careless and presumptuous way in which almost every natural historian at once settles the matter. He does not seem to admit of any doubt respecting the affair, but at once assumes it as a certainty that every species of animal was derived from one original parent, and sets himself to work to inquire which was the parent breed, and, worse than all, derives many fanciful, nay, even some practical conclusions from that which rests at best only on probability. Thus there is scarcely a writer on sheep who does not take the question at once for granted, and describe the Argali, or the Musmon, or some creature of his own imagination, as the common origin of all.

There is no doubt that one variety of domesticated animals, if prevented from mixing with any other, will in general propagate the same kind without any material change. It is also acknowledged that if, from some unknown or accidental cause, an individual is produced, possessing some unusual peculiarities, his progeny, to a certain degree, will probably possess the same peculiarities; and if a male and a female are selected with these peculiarities, and care is afterwards taken to exclude all who have them not, a new and permanent breed may be established. It is likewise sufficiently clear, that climate, soil, and pasture will gradually effect a considerable change in the form and the quality both of the wool and the flesh of every breed. These changes, however, have their limits; they go no farther than producing modifications of the former breed: the essential and distinguishing character may yet be recognised, or, if it should be rendered somewhat obscure, it will burst forth again when the animal regains his native soil and climate.

The question is, when there are varieties of a species essentially and altogether different from each other; when the act of man has and could have little to do in effecting such a difference; when there was nothing to prevent that intercourse which would soon wear down and efface every accidental variety, and restore the primitive character—the question then is, whether these variations are not best explained on the supposition of an original adaptation of each to the situation in which it was placed, and the functions it was to perform.—See Price on Sheep, p. 14.

There is reason to suppose that the breed of sheep which the Israelites tended on their departure from Egypt was essentially the same as that which Abraham possessed and Jacob improved; and these were clearly, by comparison of the two passages just quoted from Leviticus, the sheep whose fat was principally deposited, not on the tail, but on the rump, or on the upper part of the legs as connected with, and forming a part of, the rump.

### CAUSE OF THIS PECULIARITY.

Dr. Pallas has some curious speculations concerning this *Uropygium*, or fatty excrescence. Without once inquiring into the actual origin of this sheep, he traces the peculiarity of the rump to "the bitter saline pastures of Tartary, by the influence of which it has gradually augmented in size through a number of generations, like some diseases; insomuch, that the tail has gradually decayed and dwindled away to the little button we find remaining, suffocated, in a manner, by fat, as parts of the human body have been found decayed and diminished in certain cases of unnatural accumulation of fat." He also says, that "the diminution of this mass of fat in the sheep of several of the Tartar hordes is owing to the little wormwood there is in those districts, and the small quantity of salt with which the pasture is impregnated." And he says, that "when these sheep are transported into the south of Siberia, where the pasture is nearly the same as that on which the Kirguise sheep range, the uropygium shrinks to a very diminutive size."

Certainly, as Dr. Anderson well remarks, this is opening a new and very important question—one that comes home to the business and bosom of the breeder. There is proof enough with regard to every breed, that by luxuriant pasture an animal, and the descendants of that animal, may be forced up far beyond their original size; but is it possible, by dint of pasture, to increase or diminish the bulk of a particular part of the animal, his general frame being at the same time comparatively unaffected? The changes which pasture, accident, different systems of breeding, will speedily produce in the animal generally, and which will soon taint or improve the whole flock, may be easily conceived,—of the changes which disease may effect in any particular organ, or part of the frame, there are abundant proofs, and also of the hereditary character of these transformations. The condition and health and size of the animal may be influenced, and that part on which the fat is especially disposed to accumulate may appear to be more affected than any other; but this is not the question here—the condition and health and size remaining the same, can the comparative bulk of any particular limb or organ be influenced? Certainly by breeding—certainly by remembering the golden rule, that like produces like; but permanently in no other way*.

### THE MANAGEMENT OF THE PRIMITIVE SHEEP.

It has already been shown that the sheep-husbandry of the primitive ages was exceedingly simple. It consisted in a continual change of pasture, in a direction, as much as could be contrived, towards the north from winter to summer, and towards the south from summer to winter, and the contriving to pitch the temporary encampment near to some rivulet or well, whence water might be obtained for domestic purposes, and also for the flocks, which could not subsist on the products of a soil generally impregnated with saline matter, without a plentiful supply of this fluid. The driving of the flock to and from the water was the duty of the female part of the family or horde, and often the attending to the sheep during the day, in order to

* See this question treated more at length in Anderson on Sheep, p. 35, &c.

prevent their straying too far from the tents. The shepherd, however, (who was either the head of the family, or his son, or some confidential servant,) was at hand in cases of difficulty or danger; and, when night came on, the sheep were driven to the immediate neighbourhood of the encampment, or enclosed in a fold, and he lay in the midst of them or close by them either in a temporary hut, or exposed to the cold of those regions, more chilling than the heat of the day was oppressive. Jacob expresses in strong terms the occasional sufferings of the shepherd in the discharge of this part of his duty—" In the day the drought consumed me, and the frost by night, and my sleep departed from mine eyes*."

WANT OF WATER.

The occasional suffering from drought has been already hinted at. A traveller gives, from his own experience, an account of the torture that is felt when the water is exhausted on one of the sandy deserts of Africa. " Many perish victims of the most horrible thirst. It is then that the value of a cup of water is really felt. In such cases there is no distinction: if the master has none, the servant will not give it to him, for very few are the instances in which a man will voluntarily lose his life to save that of another. What a situation for a man—a rich one—perhaps the owner of caravans! He is dying for a drop of water, no one gives it to him; he offers all he possesses, no one hears him; they are all dying, though by walking a few hours further they might be saved. The camels are lying down, and cannot be made to rise; no one has strength to walk; only he who has a glass of that precious liquid lives to walk a mile farther, and then perhaps dies too. If voyages on seas are dangerous, so are those on land. At sea, one meets with pirates—they rob, we surrender or die; in the desert, they rob the traveller of his property and water; they let him live perhaps, but what a life! to die the most barbarous and agonizing of all deaths. In short, to be thirsty in a desert, without water, exposed to a burning sun, without shelter, and no hopes of finding either, is the most terrible situation a man can be placed in, and I believe one of the greatest suffering that a human being can sustain. The eyes grow inflamed, the tongue and lips swell, a hollow sound is heard in the ears which is followed by deafness; the brains seem to grow thick, the sufferer is beside himself—mad; all these feelings arise from the want of a little water; and in the midst of this misery the deceitful mirages appear to him. A broad expanse of water, clear as crystal, suddenly opens to his view. Faint and weary under the fierce sunbeam, he gazes on the unexpected relief with ineffable delight, and fondly anticipates a speedy termination to his present distress. He sees the foremost cattle enter the lake, and the water dashed about by their feet. He quickens his pace and hastens to the spot, when to his utter disappointment the pool disappears, and nothing remains but the dry and thirsty wilderness †." The reader will hereafter enter into the full force of what is meant by the '*living*,' the real fountains of water, said in the Scriptures to be prepared for his flock by the great Shepherd.

COLD.

In Europe, the days and nights seem to correspond naturally with the seasons and with each other: but it is quite otherwise in the East. In Lower Asia, in particular, the day is always hot, and as soon as the sun is fifteen degrees above the horizon, no cold is felt even in the depth of winter. On the contrary, in the height of summer the nights are intensely cold, and the better sort of the inhabitants are all clothed in furred garments, as the only means by which they can resist the chilliness of the air. A

* Gen. xxxi. 40.

† Belzoni's Researches in Egypt, p. 342.

traveller says, "sometimes we lay at night out in the open air, sooner than enter a town, on which occasions I found the weather as piercing cold as it was distressingly hot in the day time *."

WILD BEASTS.

Every portion of the country which they traversed was probably as much infested with wild beasts at that period as at the present day, or even more so, for fewer caravans then crossed the desert to disturb or destroy these unpleasant inhabitants. Jacob refers to them, and to the ravages which they committed—"That which was torn of beasts I brought not unto thee; I bare the loss of it†." David also draws a lively picture of the danger to which the shepherd was exposed from this cause—"Thy servant kept his father's sheep, and there came a lion and a bear and took a lamb out of the flock, and I went after him, (each of them in his turn), and smote him, and delivered it out of his mouth, and when he arose against me, I caught him by his beard, and smote him, and slew him, thy servant slew both the lion and the bear ‡." So, many centuries afterwards, our Saviour speaks of the hireling fleeing and leaving the sheep when he saw the wolf coming, and of the good shepherd giving his life for the sheep§.

The following passage from Haynes's Travels gives a dreadful account of the present state of a portion of the country over which the flocks of the Patriarchs periodically ranged; and the reader may form some idea of the dangers to which the ancient shepherd was occasionally exposed. "The approaching to Lene at close of day, as we did, is at once terrifying and dangerous. The surrounding country swarms with wild beasts, such as tigers, leopards, and jackals, whose cries and howlings would strike the boldest traveller, who has not been frequently in a like situation, with the deepest sense of horror ||."

THE ANCIENT DOG.

It would seem in early times, as now, the shepherd had his attendant dog. Job speaks of those "whose fathers he would have disdained to have set with the dogs of his flock ¶;" and Isaiah calls upon "the beasts of the forest to come to devour, for the shepherds cannot understand, the watchmen are blind, and they are all dumb dogs that cannot bark, sleeping, lying down, loving to slumber**." The duty of the dog, however, extended no further than guarding the flock from the attack of wild beasts: and, like the Spanish sheep-dog of the present day, he had nothing to do with the management of the sheep: on the contrary, he was a kind of abomination with the Israelites, and if not carefully watched, was more destructive to the sheep than the beast of whose approach he was to give warning. Taken away from this duty, he was a common pest and destroyer. The Psalmist refers to this when he speaks of dogs having compassed him about††; and it is remarkable that there is not an encomium passed upon the dog in the whole of the sacred volume‡‡.

* Sir John Chardin's Travels. See also Burden's Observations on Gen. xxxi. 40.
† Gen. xxxi. 39. ‡ 1 Sam. xvii. 34—36. § John x. 12.
|| Harmer's Observations, vol. iv. p. 171. ¶ Job xxx. 1.
** Isaiah lvi. 9, 11. †† Ps. xvii. 16.

‡‡"The dog loses in Barbary, as in the East in general, a part of those social qualities which make him the friend of man. He is no longer that domestic, mild, insinuating animal, faithfully attached to his master, and ever ready to defend him, even at the expense of his own life. Among the Arabs, he is cruel, blood-thirsty, always hungry, and never satisfied. His look is savage, his physiognomy ignoble, and his appearance disagreeable. The Moors grant him indeed a corner in their tent, but that is all. They never caress him, never throw him anything to eat. To this treatment, in my opinion,

### THE SHEPHERD'S COMMAND OVER HIS FLOCK.

Not possessing the assistance which the modern shepherd in enclosed countries derives from his intelligent and faithful dog, the keeper of the sheep, both in ancient and modern times, thrown upon his own resources, acquired a command over his flock which would be deemed almost incredible. Our Saviour, when delineating his own character, gives an interesting picture of the Jewish shepherd. "The sheep hear his voice, and he calleth his own sheep by name, and leadeth them out, and he goeth before them, and the sheep follow him, for they know his voice *." In a wild and boundless desert, and without his quadruped helper, it was necessary that he should have this command over them; and he acquired it by being always among them, and by treating them kindly. In a country enclosed according to the modern system, and where there are laws to restrain the plunderer, the shepherd may safely leave his sheep by night as well as by day. On our most extensive downs and wildest mountains he depends chiefly on the exertions of his dog to keep the sheep from wandering, to collect them at even, and to drive them to the fold. The eastern shepherd can only accomplish his task by exercising another kind of power over his flock, namely, that of attachment and confidence †.

"I asked my man," says Mr. Hartley, who was travelling through Greece, "if it was customary to give names to sheep. He informed me that it was, and that the sheep obeyed their shepherd when he called them by their name. This morning I had an opportunity of verifying the truth of his account. Passing a flock of sheep, I asked the shepherd the same question that I had put to my servant, and he gave me the same answer. I then bade him to call one of his sheep. He did so, and it instantly left its pasture and its companions and ran up to the hands of the shepherd with signs of pleasure, and with a prompt obedience which I had never seen excelled in any other animal. He told me, also, that many of his sheep were still 'wild,'—that they had not yet learned their names,—but that by teaching they would all learn them. The others which knew their names he called 'tame ‡.'"

This, perhaps, is a portion of sheep-management somewhat too much neglected. Why not give names to all the sheep, as well as to the prize

must the indifference of dogs towards their master be ascribed. Very often they have not any master. They choose a tent as a place of refuge; they remain there, and no further notice is taken of them. Refuse carrion, filth, anything is good enough for them if they can but appease their hunger. They are lean and emaciated, and have scarcely any belly. They seldom bite one another; but they unite against a stranger who approaches the Arab tents, furiously attack him, and would tear him to pieces if he did not seek safety in flight from this starved troop. If any person were unable to defend himself, or had the misfortune to fall, he would be in danger of being devoured, for these dogs are very greedy after human flesh."—Poiret's Travels in Barbary, vol. i. p. 253.

"During all the long tour through this dreary and melancholy city (Alexandria in Egypt), Europe and its liveliness were pictured to me only by the bustle and activity of the sparrows. I here no longer recognised the dog, that friend of man, the attached and faithful companion, the lively and honest courtier; he is here a gloomy egotist, unknown to the host under whose roof he dwells, cut off from human intercourse, without being the less a slave; he does not know him whose house he protects, and devours his corpse without repugnance."—Denon's Travels in Lower Egypt, p. 32.

* John x. 3, 4.

† Our sheepe do not follow their shepherds as they do in all other countries; for the shepherd goeth before and the sheep follow like a pack of dogs. This disobedience of our sheepe happens to us, because we let them range night and day in the field without a shepherd, which other countries dare not for feare of wolves and other ravenous beasts, but are compelled to guard them all day with great dogs, and to bring them home at night, or to watch them in their folds.—Samuel Hartlib's Legacie, 1651, p. 97.

‡ The Rev. John Hartley's Journal, Penny Magazine, Oct. 13, 1832.

ones and the bullocks? The English shepherd professes to recognize every sheep in his flock, almost as well as the huntsman knows every dog in his pack. The latter has long been accustomed to give to each hound his name, and much of the tractability and obedience of the pack depends on each individual of it recognizing first his peculiar name, and, very soon afterwards, the command, or encouragement, or intimation of displeasure that is addressed to him. This mutual recognition between the shepherd and his charge did not, perhaps, extend to every individual, and could not, if the flock was as numerous as it is described to have occasionally been in ancient times; but he selected some of the older rams whom, by feeding from the hand and other kind treatment, he accustomed to come at his call, and gradually to understand and obey his directions, and whom the rest of the flock would immediately follow *. By degrees these selected animals would perfectly understand the language or gestures of the shepherd, and at his command, and sometimes of their own accord, would collect the stragglers, and marshal them in regular order, and direct the march of the flock.

Lucian speaks of Polyphemus, the first shepherd of whose management of his sheep profane history gives any account, as ordering the ram what things he ought to do.

Homer compares Ulysses drawing up his men to a ram ordering his flock—

> From rank to rank he moves and orders all:
> A stately ram thus measures o'er the ground,
> And, master of the flock, surveys them round.
>
> POPE'S TRANSLATION†.

* There is no animal in which the principle of imitation is so strong as in the sheep. It seems to have been wisely and kindly implanted in one of the most valuable and defenceless and wandering of the domesticated animals, in order that it might be observed and taken advantage of by the intelligence of man. The leaders of the flock having been instructed and rendered manageable, the obedience of the rest is secured. It is often exceedingly difficult to drive a parcel of sheep into a narrow and unaccustomed passage or way, but if one of them is dragged even with violence into the place, the rest follow without the slightest trouble.

Mr. Wilson quotes from Dr. Anderson a ludicrous illustration of this principle:—"A butcher's boy was driving some fat wethers through Liverpool, but they ran down a street along which he did not want them to go. He observed a scavenger at work with his broom a little way before him, and called out loudly to him to stop the sheep. The man accordingly did what he could to turn them back, running from side to side, always opposing himself to their passage, and brandishing his broom with great dexterity, but the sheep, much agitated, pressed forward. At last one of them came right up to the man, who, fearing it was about to jump right over his head while he was stooping, grasped the short broomstick in both hands, and held it over his head. He stood for a few seconds in this position, when the sheep made a spring and jumped fairly over him without touching the broom. The first had no sooner cleared this impediment than another followed, and another, in such quick succession, that the man, perfectly confounded, seemed to lose all recollection, and stood in the same attitude till the whole had jumped over him, not one of them attempting to pass on either side, though the street was quite clear. As this took place during wet weather, the man was entirely bespattered over with dirt before they had all passed, and it is impossible to conceive a more ludicrous appearance than the poor fellow made on the occasion."—Illustrations of Natural History, vol. i. p. 112.

The Annual Register for 1808 affords two illustrations of this principle, of a very different character. "A few days since a serious accident happened to a flock of sheep, the property of Mr. Cooper, of Huilston Hall, who had intrusted them to the care of a boy for that day, in the absence of the shepherd, who was assisting in getting in the harvest. About the middle of the day the sheep broke from their pasture, when the thoughtless boy hastened them back again over a narrow and deep ditch. The leading sheep fell in, and the remainder passing over them, smothered twenty-five sheep and forty lambs, the whole being worth 70*l.* or 80*l.*" It is stated in the same volume that "Mr. Sparks, near Guildford, had more than eight hundred sheep in one pasture field, when being frightened by a dog, one of them jumped into an adjoining field, which was on a great descent, and then followed each other over the gap of the hedge so fast, that one hundred and twenty-three of them were killed."

† Even at the present day, and where the use of the sheep-dog is known, Daubenton

### THE MUSIC OF THE SHEPHERDS.

Ancient writers describe the shepherds of the early times as exerting considerable influence over their flocks by the power of music. Orpheus was a shepherd, and strange is the account of the magic of his pipe. Apollo, during nine years, kept the flocks of Admetus, and his rival, Pan, was also a shepherd, and, although easily vanquished when he ventured to contend with the god of music, discoursed eloquently upon the pipe. David was taken from the sheep of his father Jesse, and made the armour-bearer of Saul; and "when the evil spirit, the fit of melancholy, was upon Saul, David took a harp and played with his hand, and Saul was refreshed and was well, and the evil spirit departed from him*."

The pastures on which the sheep of the olden times fed, consisted of immense plains, or occasionally of abrupt alternations of hill and vale, with many a tangled copse and forest, so that the sheep, or a portion of them, were often out of the sight of the keeper, and occasionally beyond the reach of his voice: he therefore had a horn, or pipe, by means of which he could be heard at a greater distance, and the well-known sound of which the leaders of the flock would immediately obey. To while away the time, he would, perhaps, occasionally endeavour to draw other and more pleasing sounds from this instrument so necessary to his vocation, and thus he would naturally, or almost necessarily, become, to a greater or less degree, a musician: therefore the interesting stories of the poets are not all fictions; and it can easily be imagined that the shepherd would often be found playing on his pipe in the midst of his flock, and they apparently attentive to, and pleased with, the strain, for they would have sufficient intelligence to associate with it a sense of the kindness and protection they experienced from the player.

Goldsmith gives the following account of the shepherd-musician:—"Before I had seen them trained in this manner, I had no conception of those descriptions in the old pastoral poets, of the shepherd leading his flock from one country to another. As I had been used to see these harmless creatures driven before their keepers, I supposed that all the rest was pure invention; but in many parts of the Alps, and even some provinces of France, the shepherd and his pipe are still continued with true antique simplicity. The flock is regularly penned every evening, to preserve them from the wolf, and the shepherd returns homeward at sunset with his sheep following him, and seemingly pleased with the sound of the pipe, which is blown with a reed, and resembles the chanter of a bagpipe†."

Some illustrations of the command of the shepherd over his flock will be given when the management of the Spanish flocks in their annual peregrinations is described; one pleasing instance of it, however, the sheep-husbandry of Messrs. Nowlan, of Kilkenny, will afford. Their stock in 1820 consisted of 600 pure Merinos. During the summer they were pastured upon a farm of good natural herbage improved by grass-seeds and clover; in winter they were housed in the day during wet

thus describes the duty and the practice of the French shepherds. "They select certain sheep from the flock; they give them particular names, and teach them to come when they are called. In order to accustom them to this, they make the sheep follow them by offering them a piece of bread. When the shepherd wishes to lead his flock through a defile, or to make them change the direction in which they are proceeding, he calls to him one of these selected sheep. Those that are nearest to him immediately follow, and the others are not far behind, and so by degrees the whole flock is disposed to obey the call of the shepherd, and to follow him."—Instructions pour les Bergers, p. 15.

* 1 Sam. xvi. 14-23.

† Goldsmith's Animated Nature, vol. ii. p. 59.

weather. They were all under the charge of one young man. No dog was permitted, all was done by the shepherd himself. At the sound of the horn all the sheep flocked around him if he stopped, and followed him if he moved forward. Salt was the medium by which this docility was chiefly produced, and the reporter adds,—"any shepherd who accustoms his sheep to the use of salt, and carries a little about him as a reward for their attention to his call, will be followed by them wherever he pleases to lead the way."

The farm is divided by the King's River, at times so rapid and impetuous as not to be fordable by the strongest horse. A plank bridge, about eighteen inches wide, and one hundred and ten feet long, with a head-rail on one side, is thrown across for the convenience of passengers. When it is necessary to move the sheep from one side of the river to the other, the shepherd has only to cross this plank, sounding his horn, and each individual of the flock paces regularly after him in single file, without any instance of casualty, even at the time of the highest floods*."

This kind of sheep-management is not, however, to be expected in the present day, nor could it be made compatible with the altered and improved state of British husbandry; but there are several passages in the older writers on agriculture, which abundantly prove that this part at least of the patriarchal system was not unknown by the British shepherds. Barnaby Googe, who wrote in 1614, and from whom some excellent maxims will be occasionally quoted, thus expresses himself,—there is, perhaps, a little of the romance of the pastoral life of former times about it, but it was well founded on the habits of the animal, and the customs of the times. "Moreover, the shepherds must deale gently and lovingly with their flocke, and comforting and cheering them with singing and musicke, for this kind of cattel taketh great delighte in musicke, and it doth them as much good as their pasture. Beside, they must be well ware in the driving of them and ruling of them, that they guide them with their voice, and shaking of their staffe, and not hunting of them†."

### THE HUMANITY OF THE SHEPHERD.

Connected with this is another interesting feature in the character of the nomadic shepherd—humanity. Their frequent change of situation in search

* The Farmer's Magazine, August, 1820. The use of the horn for the collecting and management of sheep was well known in early times. Polybius says that the flocks in the island of Cyrnon, on the landing of any stranger, always fled into the interior of the country, but when the shepherd blew his horn, they scampered around him and forgot all fear.—See also Bulkeley's Notes on John x. 4.

Other domesticated animals have been taught the same obedience to the herdsmen. "In Lithuania and Muscovy, as soon as the sun has risen, the herdsman daily winds his horn. On the well-known signal, the stalls being instantly opened, the horses, mules, asses, goats, heifers, and bulls obey the signal without reluctance. As soon as they are assembled in a body, he marches at the head of them, while they quietly follow their leader into such meadows as he sees most convenient for them. By a second signal they are led to water, and, by a third, re-conducted home again, where each repairs to his own proper stall without the least disorder or confusion."—Nature Delineated, vol. iii. p. 25.

"The shepherds in Sweden, as well as in Iceland, have horns made of birchwood. Two excavated pieces of birchwood are fitted together, and bound tightly round with the bark of the same tree, so that one circular pipe is formed. The sound made by this horn is shrill, but not unpleasant. The sheep and cattle will come together at certain places and times obedient to this call."

It is in the same manner that the cattle are collected by the herdsmen of the Alps.—Acerbi's Travels in Sweden and Lapland, vol. i. p. 30.

† Dyer, in his "Fleece," speaking of the "airy downs and gentle hills," the open and elevated country, where this system of management might be with most advantage

of pasture and of water, and the long marches which they were sometimes obliged to take when many of the lambs were newly dropped, or the ewes were big with young, compelled them to adopt a system of attention and kindness to their flocks, which, not being required from the modern shepherd, is not practised or understood by him. Thus Jacob addresses Esau—"My Lord knoweth that the children are tender, and the flocks and herds with young are with me; and if men should overdrive them one day, all the flock will die*." Thus the prophet speaks of the Messiah—"He shall feed his flock like a shepherd; he shall gather the lambs with his arm, and shall carry them in his bosom, and shall gently lead those that are with young." In the descriptions already quoted of the manner in which encampments of the shepherds are moved, provision is always made for the young lambs. "Some beasts of burden, guided by the young men, bear the little ones just dropped, and not able to travel†." "The little children, just able to toddle along themselves, are employed in driving, at their own slow pace, the lambs a little older‡." "One evening," says M. de Brisson, in his history of his captivity among the Arabs, "as I was returning with our flock, one of the ewes brought forth a lamb on the declivity of a little hill; I took it up in my arms, and, with equal care and tenderness, hasted to carry it to the tents."—P. 37.

"In flowery spring-time, when the new-dropped lamb,
Tottering with weakness by its mother's side,
Feels the fresh world about him, and each thorn,
Hillock, or furrow, trips his feeble feet,—
Oh, guard him carefully! §"

Sir John Chardin, undesignedly, gives a satisfactory comment on Jacob's apology to Esau for not attending him on his journey. "Their (the Arabs') flocks feed down the place of their encampment so quick, by the great numbers which they have, that they are obliged to remove them too often, which is very destructive to the flocks, on account of the young ones which have not strength enough to follow‖."

The parable of Nathan describes the fondness for animals, and the care

adopted, and describing the usual healthiness of the sheep in such situations, says, that they

"Nor of halt,
Hydropic tumours, nor of rot, complain;
Evils deformed and foul; nor with hoarse cough
Disturb the music of the pastoral pipe;
But crowding to the note, with silence, soft,
The close-woven carpet graze."—Book I.

Ellis, in his "Shepherd's Guide," quoting from an old French author, says, "He must accustom himself to two sorts of cries, the one pleasant and shrill, to make them go forward; but another and diverse cry to call them back, that the sheep, hearing these two different cries, may learn and apply themselves to do that which thereby is commanded them. He must sometimes make them merry, cheering them up with songs or else by his whistle and pipe, for the sheep at the hearing thereof will feed the more hungerly: they will not straggle so far abroad, but they will love him the better." "Hence it is, I suppose," Ellis adds, "that some shepherds divert themselves with playing on the tabor and pipe, as some do at this time in England, and as they did in France when this French author wrote."—P. 3.

The same quaint but valuable writer describes a person who lived in the neighbourhood of Hempstead in 1747, that was remarkable for the loudness of his whistle, and who was called "the Whistling Shepherd." "He had by means of it a perfect command of his dog, who left off driving the flock, or a single sheep, and came to him at once from a considerable distance, and who had equal command over his sheep; for as soon as he appeared at the end of the field or the common, and gave the usual signal, although scattered widely apart, they would immediately form into a close compact body and march towards him."—P. 63.

* Gen. xxxiii. 13.
† Buckingham's Palestine.
‡ Buckingham's Palestine.
§ Dyer's Fleece, Book I.
‖ See also Harmer's Observations, vol. i. p. 126.

bestowed on them occasionally exhibited by the people of that time. It was evidently a picture of home life. "There were two men in one city, the one rich, and the other poor. The rich man had exceeding many flocks and herds, but the poor man had nothing but one little ewe-lamb, which he had bought and nourished up, and it grew up together with him and with his children: it did eat of his own meat, and drank of his own cup, and lay in his bosom, and was unto him as a daughter *."

### SHEEP-SHEARING.

At what period the grand improvement in the management of the sheep, the periodical separation of the wool from the pelt—the shearing—was introduced, is not known. It had probably been observed that in most climates in which there is considerable difference of temperature between the winter and the summer, the fleece is naturally detached during the latter season. As the spring advances, it is no longer needed to defend the animal from the cold—it has become, from its weight and its warmth, a nuisance rather than a comfort—the supply of nutriment is therefore cut off at the base, the bulb whence it sprung withers away, its attachment to the skin ceases, and it is only held on the back of the animal by the interlacing and entanglement of its fibres. Portions of it are now torn off by every thicket, and become lost or spoiled. The ingenuity of the sheep-owner would be exercised in saving as much of the wool as he could. He would watch the time when it was beginning to be thrown off, and he would endeavour to hasten the natural process. The earliest and rudest method was to drive the flocks hastily through a narrow passage, when by their pressure against each other the greater part of the fleece was loosened, or completely detached.

To this succeeded another mode, which had an appearance of inhumanity about it. The sheep was caught and the fleece was pulled from its back. The animal, however, did not often experience much pain in this operation, for when the fleece began to be so loosely attached to the pelt that it was separated by almost everything against which it rubbed, no great force was needed to separate it entirely †.

Of one of the varieties of the sheep of the patriarchs—the Persian—it is reported that when they feed upon the new grass between January and May, the whole of their fleeces drop off as it were spontaneously, and the animals are left "as bare" (in the elegant language of the author, Yarrenton) "as a scalded sucking-pig ‡." There is no proof, however, that this was the case with the ancient Persian sheep, much less that it could be affirmed of the flocks of the patriarchs generally. The shepherd watched the time when the outer layer of wool began to separate, and being assured from long experience that it was usually about the same season of the year, a happy thought suggested the use of the shears, in order to secure the whole of the fleece in its most perfect state.

* 2 Sam. xii. 1, 2, 3. Bochart gives several illustrations of their humanity to animals. Hieron., p. i. lib. ii. ch. 43.

† If Mr. Low's account, however, is to be credited, too much cruelty does sometimes accompany this method of obtaining the fleece. He thus describes the practice which prevailed in the Orkney Islands in his time. "About midsummer there is a particular day published for *rowing*, when all the men in the parish attend with their dogs, turn out and drive the whole flock, without any preparation of washing, into narrow pens, and from thence I may say to the place of execution, where the wool is torn off their backs; an operation which brings their whole blood into their skin, and is not only disgusting, but, if the season proves harsh, is the cause of great destruction. But, however cruel it may seem, it is almost the only notice that is taken of these useful animals by their unfeeling masters until that time twelvemonth."—Fauna Orcadensis, p. 7. In Iceland, also, the sheep are never shorn, but the wool is pulled off by the hand when it has become loose.—Gill's Technological Repository, vol. ii., p. 18.

‡ Agricultural Magazine, July, 1810.

Most of those who have treated on the early history of this animal have traced the practice of sheep-shearing to the time of Hesiod. By him, in fact, it is first mentioned as having been common among the Greeks, but the sacred writings prove that it was of much earlier date. Eighteen hundred years before the birth of Christ, and nine hundred before the time of Hesiod, is it recorded that "Laban went to shear his sheep*."

These wandering shepherds, however inferior they might have been to other nations in many of the arts of civilized life, far excelled them in the management and care of these useful animals. When Rome was founded, two hundred years after the time of Hesiod, the custom of pulling instead of shearing off the wool prevailed. The word *vellus*, a fleece, was derived from the pulling or tearing away of the wool; and the part of the Palatine Hill called *Velleia* was so named on account of its being the spot where the Romans used to pull their wool, before the Etruscan method of shearing was introduced. When Rome was in the zenith of her glory, the more effectual and humane operation of shearing was not universally adopted in Italy. Pliny expressly says, "the sheep are not everywhere shorn, but the custom of pulling off the wool (*vellendi mos*) continues in some places;" and he adds, that which was a disgrace to the age, "that the poor animals were kept fasting three days before the 'pulling,' in order that, the sheep being thus rendered languid and exhausted, the roots of the wool might be more easily detached." How superior to the conquerors of the world do the patriarchs appear in the noblest art, that of humanity†!

It was not every where in the eastern countries that convenience could be found for the washing, which then, as in most places now, preceded the shearing; and Laban was compelled to drive his flock to a considerable distance for this purpose; it was not until "the third day" that "it was told Laban that Jacob had fled‡."

Of the preparation for, and the manner in which the operation was performed, it could not be expected that these early records would speak; but there can be no doubt that when sheep were so numerous, and formed so considerable a part of the riches of the owner, every convenience would be provided for the occasion: accordingly a building seems to have been erected for this especial purpose. Jehu "slew the brethren of Ahaziah at the pit of the shearing-house§." This was nearly nine hundred years after that change of colour in the sheep, first introduced by Jacob, which rendered "the pit of the shearing-house," the pool in which the sheep were washed previous to the shearing, absolutely necessary.

Then, as now, the sheep-shearing was the season of peculiar rejoicing. It was the harvest of the shepherd, and when he had gathered it, a good feeling taught him, as it has taught the agriculturist in every country and time, to make glad the hearts of the labourers for a few hours at least. Even churlish Nabal could not refuse this, for he asks of the servants of David, "Shall I take my bread and my water, and my flesh that I have killed for my shearers, and give it unto men whom I know not whence they be?" At a little later period another, but not very pleasing, account is given of the festivities of that season: "And it came to pass that Absalom had sheep-shearers in Baal-hazor, and Absalom invited all the king's sons, and Absalom commanded his servants, saying, When Amnon's heart is merry with wine, then kill him‖."

* Gen. xxxi. 19.

† See Wilson on the Sheep. Quarterly Journal of Agriculture, vol. ii. p. 365.

‡ Gen. xxxi. 22. § 2 Kings x. 13-14.

‖ 2 Sam. xxiii. 23, 28. The close of harvest was a season of rejoicing in most of the ancient nations, and sheep-shearing was the harvest of the nomadic shepherd. This periodical festival was even enacted by law. Cecrops, the founder of the kingdom of Athens, about the time of Moses, ordained that "the master of every family should after

Without entering at present into the question relating to hogget-wool, or the period of the first clipping of the lamb, it may be mentioned that there is a passage in Deuteronomy which may account for the origin of the delay of the first shearing. It has principal reference, however, only to the firstlings or the first born of the flock, which were claimed for religious purposes. "All the firstling males that come of thy herd, and of thy flock, thou shalt sanctify unto the Lord thy God; thou shalt do no work with the firstling of thy bullock, nor shear the firstling of thy sheep*."

One passage more with reference to the shearing of the sheep will place the docility of that animal, and the humanity of the shepherd, in a very pleasing point of view: it is the account given by the prophet Isaiah of the sufferings of the Messiah, and the meekness with which he endured them. "He is brought as a lamb to the slaughter, and as a sheep before her shearers is dumb, so he openeth not his mouth †." He who has witnessed only the noise, and confusion, and frequent brutality of a modern sheep-shearing, can with difficulty picture to himself quietude in the sheep so complete as this. One, however, who witnessed the management of the sheep in Palestine, a philosopher, a Jew, without direct reference to this passage, and without seeming to have it in his mind, gives a perfect commentary on it. "Woolly rams laden with thick fleeces put themselves into his hands (the shepherd's) to have their wool shorn, being thus accustomed to pay their yearly tribute to man, their king by nature. The sheep stands in a silent inclining posture, unconstrained under the hand of the shearer. These things may appear strange to those who do not know the docility of the sheep, and shepherds might be much assisted in this government by giving them names while in the state of lambs, and using them to go and come daily by those names‡."

There are not any passages which indicate that the Israelite shepherds were in the habit of clothing their sheep after the shearing. There is no reason to suppose that these animals ever became so excessively fat as to render it necessary for them to be shorn in an early period of the season, and thus be exposed to danger from the cold: and then only could clothing be justified on account of the expense with which it is attended, whatever may be said of its effect on the sheep and the wool§.

It is certain, however, that the Greeks were accustomed to clothe their flocks. "Pursuing our walk," (in the neighbourhood of Athens,) says the pretended but highly instructive Anacharsis, "we passed by a numerous flock of sheep, preceded and followed by dogs to drive away the wolves (Xen. Memor. lib. ii. p. 757): a covering of skin was wrapped round each sheep. This practice, which has been borrowed from the Megareans (inhabitants of the Isthmus of Corinth, Lus. in Areopag. p. 136 and 143), defends the wool from the filth which might otherwise defile it, and prevents it from being torn by the hedges. I know not whether it contributes to render the wool finer, but I can affirm that the wool of Attica is extremely fine ‖." (Varr. de Re Rustica, lib. ii. c. 2.)

The system of *cotting* was known and adopted by the Israelites. After repelling the invasion of Sennacherib, Hezekiah applied a portion of the spoil to works of public utility; he built "storehouses, for the increase of

harvest make a feast for his servants, and eat together with those who had taken pains together with him in tilling his ground." See Burder's Oriental Literature, vol. ii. p. 77.

* Deut. xv. 19.

† Isaiah liii. 7.

‡ Philo-Judæus on the Creation, c. i.

§ Young's Annals of Agriculture, vol. xli. p. 515.

‖ Travels of Anacharsis the Younger in Greece, vol. iv. p. 519.

corn, and wine, and oil, and stalls for all manner of beasts, and cotes for flocks*." This has reference more to the inhabitants of considerable towns or cities than to the wandering shepherds, of whom principally mention has hitherto been made.

A very curious, but not accurate, account of the earliest system of cotting is given by a writer in the Annals of Agriculture. He says that "the ancients were so perfectly satisfied that a variety of climate was absolutely necessary to the production of fine wool, that those people whose situation admitted not of any change, had recourse to art,—housing them from the day to defend them from the too powerful rays of the sun, and exposing them to the cold of night. This was practised by Hezekiah; Columella informs us that the same conveniences were adopted in Greece and Tarentum, and there is a line in Milton's Lycidas confirming the custom of their nocturnal exposure:—

'Battening our flocks with the fresh dews of night.'"

The cotting which has been practised in modern times, however, has had universally reference to the night. The sheep are collected together in these buildings for the double purpose of defending them from the cold, and preserving their dung as manure; and, from the accounts which are given of the sheep-husbandry of the remotest times, it is clear that these were the objects of the primitive shepherds. Polyphemus is represented by Homer as driving his flock at eve to his rude cote, a rocky cave†. Virgil expressly describes the cote as designed to "fend the bitter cold, and prevent the diseases produced by it ‡." The same poet furnishes a satisfactory explanation of Milton's dews of night, when, not having the modern fear of the early dew before his eyes, he counsels,—

"Before the sun, while Hesperus appears,
First let them sip from herbs the pearly tears
Of morning dew §."

They were to "batten on the fresh dews of night" before these were evaporated by the rising sun; and Columella himself speaks of "the folds not being resorted to on account of the great number of wolves,—the hurdles of which they were composed affording a very insufficient protection from these animals,—but, in order that their dung might be saved, buildings were erected into which they were driven every night all the year round ||."

## WEAVING.

Of the use of the wool for clothing, in those early times, the scriptures afford many unequivocal proofs. Job, who is supposed to have lived

* 2 Chron. xxxii. 28.

† Odyssey, lib. ix.

‡ Incipiens stabulis edico in mollibus herbam
Carpere oves, dum mox frondosa reducitur æstas:
Et multa duram stipula, filicumque maniplis
Sternere subter humum, glacies ne frigida lædat
Molle pecus, scabiemque ferat, turpesque podagras.—Georg. III. v. 293.
First with assiduous care from winter keep
Well foddered in the stalls thy tender sheep.
Then spread with straw the bedding of thy fold,
With fern beneath, to fend the bitter cold.
That free from gout thou may'st preserve thy care,
And clear from scabs produced by freezing air.—Dryden.

§ Georgic III.

|| Bradley's Synopsis of Columella, &c., p. 59.

before the escape of the Israelites from Egypt, says, "Let me be condemned if I have seen any perish for want of clothing, or any poor without covering; if his loins have not blessed me, and if he were not warmed with the fleece of my sheep*": *i. e.*, if his loins did not admonish him to bless me when he felt himself warm by the clothing made from my wool. Woollen cloths, then, furnished a part of the usual dress. But might not this cloth have been produced by the first and rudest process of manufacture,—the beating and compressing of the wool together,—and by means of which the fibres were entangled and adhered, and a coarse, yet comfortable kind of cloth, was made? The same book will settle this question: Job is complaining of his sad estate, and fancies himself near unto death, and he says, "My days are swifter than a weaver's shuttle†"; swifter than its motion through the warp that is stretched across the machine. This affords an unequivocal proof that the art of weaving was then known.

A comparison with other passages will show that this art was in no rude state, and therefore, probably, was of no recent invention; for, in order to repress that pride in gaudy apparel which is the foible of every age, the Jews are forbidden to wear clothes made of two different materials, as linen and wool interwoven‡. The skill of the manufacturer is also spoken of in very high terms. Moses alludes to those whom "God had filled with wisdom of art (all human acquirements are naturally traced to Him by whom the spirit of intelligence was originally bestowed) to work all manner of work of the engraver, and of the cunning workman, and of the embroiderer in blue and in purple, in scarlet and in fine linen, and of the weaver, even of those that devise cunning work§."

It will now be natural to look back to the history of Joseph, three hundred years before the escape of the Israelites from Egypt, and inquire whether the coat of many colours with which a fond and foolish father decorated a favourite son, was not likewise a proof that the art of weaving woollen cloth then existed, and, even among the wandering shepherds, had attained a considerable degree of perfection. It is at least a proof that the art of dyeing was known and commonly practised.

Very early in the history of the Twelve Tribes after their settlement in Canaan mention is made of the employment of the women in weaving. When Samson slept in the lap of Delilah, she was busily employed in using his hair as the warp of her loom.

"If," said he to his false mistress, "thou weavest seven locks of my head with the web, I shall be in thy power. And she did so; and she fastened it with the pin, and said unto him, The Philistines be upon thee, Samson. And he awaked out of his sleep and went away with the pin of the beam, and with the web‖."

A short time after the period in which Samson lived, it is recorded that the mother of Samuel "made him a little coat, and brought it to him from year to year," when she came up with her husband to offer yearly sacrifices. And, at a somewhat later period¶, Solomon thus describes the good wife,—"She seeketh wool and flax, and worketh willingly with her hands. She perceiveth that her merchandise is good. Her household are clothed with scarlet**."

* Job xxxi. 20.
† Ib. vii. 6.
‡ Deut. xxii. 11.
§ Exod. xxxv. 35.
‖ Judges xvi. 14.
¶ Sam. ii. 19.
** Proverbs xxxi. 13, 18, 21.

### THE EARLY SHEPHERDS THE INVENTORS OF WEAVING.

Moses legislated some centuries before the golden fleece arrived in Greece; and the Patriarchs tended their flocks long ere the inhabitants of that country began to be civilized. The art of manufacturing the fleece of the sheep into clothing was well known by the early shepherds,—not merely the rude process of felting, but the superior pliability, and beauty, and easiness of adaptation, and comfortable feeling which result from the mechanism of the loom and the shuttle. Those primitive shepherds, however, whose history, as associated with the sheep, has been rapidly traced, were connected with Egypt. Abraham sojourned there; and the descendants of Jacob were captives in Egypt more than one hundred and fifty years. Modern historians have united in tracing the invention of weaving to the Egyptians,—the weaving not of wool, however, but of flax; and the fabric of the linen cloths in which some of the Egyptian mummies were wrapped has scarcely been excelled at the present day. Yet it may be questioned whether the claims of the nomadic shepherds have been fairly considered. The cultivation of the sheep was coeval with the expulsion from Paradise: the cultivation of flax must have been an improvement in husbandry of far later date. When the descendants of Noah were scattered, they pursued their old avocation,—their flocks and their herds accompanied them until they chanced to find some peculiarly fertile and convenient tract, which they gradually made their permanent abode; and then, building cities for themselves, they by degrees changed their way of life, and applied the arts, which they already possessed, to other and more extensive purposes.

The children of Mizraim, the offspring of Ham, found in Egypt a soil not well fitted for the prosperous management of the sheep. The Nile overflowed its banks twice in the year; and when its waters receded, a surface was left that was soon covered with luxuriant vegetation, but which infected and destroyed the sheep that fed upon it. Accident or experiment, however, soon proved that it was favourable to the cultivation of flax, and that from the fibres of the flax fine linen might be woven. Did the discovery of the flax lead to the invention of weaving, or was an art, known and practised for many a century before, directed to the manufacture of this new material? The latter is the more probable supposition, especially if it is recollected, that during the early period of the history of the Patriarchs, some associated tribes, that had previously inhabited the country to the east of Egypt, invaded and conquered the districts bordering on the Nile, and established a dynasty there under the appellation of the Shepherd Kings. The Abimelech, with whom Abraham had controversy, and who presented to him sheep, oxen, and slaves, was one of those shepherd kings.

To Egypt, then, let the honour still be yielded of having first woven the fibres of the stalk of the flax into linen; but the invention of weaving—the conversion into cloth of the animal fibres that grow on the back of the sheep—is a claim of yet more ancient date, and belongs either to those who wandered with their flocks far from the plains of Ararat, or who carried the customs and arts of their forefathers into the country which they subjugated.

### THE EMPLOYMENT OF THE WOMEN.

The simplicity and small bulk of the loom enabled the female, whether in the tent of the wanderer or the settled residence of the citizen, to employ herself in the manufacture of clothing for her husband and her family.

A modern traveller thus describes the loom at present found among the Arab shepherds:—

"The Arab women use a very simple loom; it is called *nutou*, and consists of two short sticks, which are stuck into the ground at a certain distance according to the desired breadth of the *shauke*, or piece to be worked. A third stick is placed across over them; about four yards from them three sticks are placed in the same manner; and, over the two horizontal cross sticks, the woof (*sadouh*). To keep the upper and under woof at a proper distance from each other, a flat stick, called *mensebhk*, is placed between them. A piece of wood serves as the weaver's shuttle, and a short gazelle's horn is used in beating back the thread of the shuttle. The loom is placed before the *maharrem* or women's apartment, and worked by the mother and her daughters. The distaff (*maghezel el souf*) is in general use among the Aenezes. At Palmyra I saw several men using the distaff; and among the Kelby Arabs all the shepherds manufacture wool*."

From another traveller it appears, that even a perfect loom is not indispensable to the manufacture of woollen cloth! To this day, in Barbary, women are employed in the manufacture of their *hykes*, or blankets, who do not use the shuttle, but conduct every thread of the wool with their fingers †.

It may now be easily understood how Hannah provided the yearly little coat for her son Samuel. By a singular coincidence, as nearly as possible about the same time, but in other countries, Penelope is described as unravelling at night all that she had woven in the day; Helen, with all her faults, is found employed at the loom; and even Calypso and Circe are spoken of as busied in household duties of this kind ‡. Many centuries after this, the unfortunate Lucretia, when visited by Tarquin, was employed in carding and spinning wool with her domestics. Alexander the Great presented the ladies of the Court of Darius with some woollen cloth, the workmanship of his mother and sisters. It is true, that in his anxiety to treat his prisoners with courtesy, and at the same time to display the excellent qualities, as he supposed, of those who were dear to him, he forgot the debased character of the luxurious and enslaved people whom he had conquered, and gave offence by the homeliness of the present. Still later, however, and returning to the capital of the world, and in its state of greatest luxury, Augustus was not ashamed to boast that he wore the clothes which had been manufactured by his wife and sister and daughters. It will be seen, when the history of the sheep is traced down to the present day, that in every country and in every age, while simplicity of manners and the truest virtues of the female character were retained, such was the ordinary and chosen employment. "She maketh herself," says Solomon, "coverings of tapestry; her candle goeth not out by night. She layeth her hands to the spindle, and her hands hold the distaff §."

There is a passage in Virgil which affords a beautiful illustration of this description of the employment of the good wife; indeed, it bears so

* Notes on the Bedouins and Wahabites, by Lewis Burckhardt, p. 38.

† Shaw's Travels, p. 224.

‡ Homer's Iliad, iii. v. 25, and Odyss. ii. 94, and vi. 52.

§ See Theocrit. Idyll. 15.; Suetonius, Aug. 73.; and Fleury's History of the Israelites, p. 72. See also a Tract on Wool, by Mr. Wansey, somewhat erroneous in the principle which it advocates, but full of interesting information with regard to the history of wool.

great a resemblance to it, that it might almost pass for a poetical imitation.

> "Night was now sliding in her middle course:
> The first repose was finished: when the dame
> Who, by her distaff's slender art subsists,
> Wakes the spread embers and the sleeping fire.
> Night adding to her work, and calls her maids
> To their long tasks by lighted tapers urged*."

EMBROIDERY.

A passage in the book of Judges shows that the art of embroidery was not only known, but carried to great perfection, at an early period of the history of the tribes. The Israelites had done evil in the sight of the Lord, and were for twenty years oppressed by Jabin, one of the most powerful of the kings of Canaan. At length they rebelled, and Sisera, the captain or commander-in-chief of Jabin's troops, assembled a considerable army to quell the rebellion. Some time elapsed, and he returned not to his family, nor had any tidings of him reached them. His mother stood at one of the windows of her house anxiously looking out for him, while her wise ladies (her ladies in waiting) were trying to console her. Their argument is very characteristic. "Have they not sped?"—It is not possible that they could have failed. "Have they not divided the prey?"—Are they not now delayed by the division of the prey? "For every man a slave or two. To Sisera a prey of divers colours, a prey of divers colours of needlework, of divers colours of needlework on both sides meet for the necks of them that take the spoil†!"

It is singular that Homer, speaking of the Greeks seventy or eighty years after this, describes the progress of this art among them,—he speaks of the "painted garments" adorned with flowers and trees in beautiful colours. Pliny‡ says, that after this the Phrygians, not far distant from Canaan, wrought these with needles. Still later they were interwoven with various coloured worsteds, and with gold thread; and at a more distant period, a beautiful kind of embroidery was made at Babylon, called, on account of its execution and value, "Babylonish Garments." It was the sight of one of these, amidst the spoils of Jericho, that tempted Achan, one hundred and sixty years before, to break the Divine command§. It further appears that only the higher class of persons were permitted to wear these Babylonish robes‖; which are, therefore, by anticipation, appropriated to Sisera as his share of the spoil. It is really pleasing to be able to collect these singularly accurate confirmations of the sacred history, and likewise to see the arts of various kinds flourishing among the Israelites and in their neighbourhood, at a time when they were perfectly in their infancy in those countries that were afterwards the especial residence of science and philosophy.

TITHES.

According to the Levitical law, sheep, as well as "all the seed of the land and the fruit of the tree," were tithed. In the last chapter of Leviticus, the method of separating the tenth is pointed out in somewhat obscure terms. "And concerning the tithes of the herd, or of the flock, even of whatsoever passeth under the rod, the tenth shall be holy (shall be devoted) unto the Lord. He shall not search whether it be good or bad, neither shall he

* Æneid. viii. v. 407,—Trappe's Translation.
† Judges v. 20. ‡ Lib. viii. c. 48. § Joshua vii. 21.
‖ Burder's Oriental Customs, vol. ii. p. 88.

change it *." The explanation of this is curious and satisfactory. "The cattle were all brought into a sheep-cote, in which there was but one gate, and that so narrow as to suffer only one to come out at a time. The dams being placed without, and the gate opened, the young ones were invited by their bleating to pass out to them. As they passed by, one by one, a man who stood at the gate with a rod coloured with ochre, told them in order, and when the tenth came out he marked it with his rod as the tithe sheep †."

### THE BREED OF BASHAN.

Whether there were different breeds of sheep, or different varieties of the same breed, cultivated for particular purposes, cannot be determined. Speaking, however, of benefits that had been conferred on the Israelites, Moses alludes to rams of the breed of Bashan as a peculiar and superior sort ‡. In other parts of scripture the bulls of Bashan § are mentioned. It was a district that fell to the lot of the tribes of Reuben and Gad, being part of the land of Gilead, and celebrated for its rich pasturage. Cattle and sheep probably sooner fattened there and grew to a larger size, but there is no reason to suppose that there was any other peculiarity in the breed.

### THE MALE ONLY EATEN.

By comparing together various detached parts of scripture, some additional information may be obtained regarding the sheep, as contributing to the food of man. The history of the patriarchs, the regulations of the Mosaic ritual, and a few occurrences of later date, casually mentioned, prove that its flesh was eaten, yet not as ordinary food; it was reserved for occasions of peculiar festivity, or for the hospitable entertainment of the stranger. But the male only was, with few exceptions, destroyed; the Paschal lamb was a male—those offered in sacrifice were usually males—and Jacob, pleading the fidelity with which he had served Laban, protests, "the rams of thy flock have I not eaten ‖." When such a system was pursued, it will not be surprising that the flocks of the patriarchs were so numerous, and that those of the Arabs of the present day, who have nearly the same customs, are numerous too.

### HOSPITALITY OF THE ARABS RESUMED.

Some facts, related in the continuation of the Old Testament history, give a more extended view of the hospitality of the shepherds. A lamb or kid was usually selected for the entertainment of the stranger. It was roasted or seethed in its own gravy, and often served whole; and that which remained after the feast, or a part of it, was given to the traveller to support him on his journey. When Gideon was summoned to become the deliverer of Israel, he mistook the heavenly messenger for a prophet, and with all the hospitality of his vocation and of the time in which he lived, "he made ready a kid and unleavened cakes of flour, and he put the flesh in a basket, and he put the broth in a pot, and brought it out unto him under the oak ¶." Harmer well observes that there is a passage in the narrative of a modern traveller that affords a perfect commentary on this. "Besides a bowl of milk and a basket of figs, raisins and dates, which were presented to us immediately on our arrival, the master of the tent where we lodged fetched us from his flock a kid, a goat, a lamb, or a sheep, according to the

* Lev. xxvii. 32, 33.
‡ Deut. xxxii. 15.
‖ Gen. xxxi. 38.
† Burder's Oriental Literature, vol. ii. p. 62.
§ Psal. xxii. 12.
¶ Judges vi. 19

number of our party, half of which was seethed by his wife and served up, and the rest was made *kab-ab*,—this is cut into pieces, roasted, and preserved for our breakfast or dinner next day *. May we not suppose that Gideon, having presented some slight refreshment to the supposed prophet, killed a kid, seethed a part of it, and brought the stewed meat in a pot with unleavened cakes of bread, and the *kab-ab* in a basket, to be carried away with him in order to serve him for some after-repast on his journey ?†"

### THE DELICACY OF THE LAMB.

When the primitive shepherds indulged themselves with animal food, the flesh of the lamb was considered as an especial dainty. Thus Amos speaks of those "who lie upon beds of ivory, and stretch themselves upon their couches, and eat the lambs of the flock, and the calves out of the midst of the stall ‡." Sir John Chardin, who travelled through Palestine and the neighbouring countries, says that "the lambs of this breed, with the accumulation of fat about the haunches, must be eaten in order to form a conception of the moisture, taste, and delicacy of this animal." Hence they were used as presents; Samson sent one to his father-in-law, and Jesse, when he brought his son David to Saul, made him the bearer of some bread, a bottle of wine, and a lamb. It is probably with reference to this delicacy that the Psalmist speaks of his soul being satisfied as with marrow and fatness §.

Particular parts of the lamb were considered as especial delicacies. When Samuel entertained Saul, the future king of Israel, "he brought him into the parlour, and made him sit in the chiefest place among them that were bidden, which were about thirty persons; and Samuel said unto the cook, Bring out the portion which I gave thee, of which I said unto thee, set it by thee; and the cook took up *the shoulder* and that which was upon it, and set it before Saul ‖." The shoulder of the lamb, of the present breed, before the fat begins to accumulate about it, is no bad dish, although it would not now be selected as quite the favourite one. There is no disputing, however, about tastes. The reader will find a somewhat ludicrous, but a singularly satisfactory illustration of this passage in a note ¶.

The lamb or the kid was not, however, to be seethed in its mother's milk **. This was not because there appeared to be something revolting and unnatural in employing that with which the mother had nourished her young, in preparing it for the table, but because a superstition, derived from an idolatrous practice, was connected with this method of dressing the lamb. "It was a custom of the ancient heathens, when they had gathered in all their fruits, to take a kid and boil it in the dam's milk; and then, in a magical way, to go and besprinkle with it all their trees, fields, gardens, and orchards, thinking by this means they should make them bring forth more abundant fruit the following year. Wherefore God forbad his people, the Jews, at

* Shaw's Travels, p. 12.

† Harmer's Observations, vol. i. p. 330.

‡ Amos vi. 4.

§ Psal. lxiii. 5.

‖ 1 Sam. ix. 22, 23, 24.

¶ "Abdomalek, the Califfh, upon his entering Cufah, made a splendid entertainment. When he sat down, Amron, the son of Haroth, an ancient Mechzumeàn, came in. He called him unto him, and placing him by him upon his sofa, asked him what meat he liked best of all he had ever eaten. The old Mechzumeàn answered, an ass's neck well seasoned and well roasted. What say you, says Abdomalek, to a leg or shoulder of a sucking lamb well seasoned and well roasted, and covered over with butter and milk?"—Oakley's History of the Saracens, vol. ii., p. 277.

This perfectly explains why it was set apart for the future monarch, and it probably explains too what it was that was upon the shoulder.

** Exod. xxiii. 19.

the time of their ingathering to use any such superstitious or idolatrous rite *."

It was forbidden to eat any of the flesh (referring principally to sheep) that had been torn by wild beasts †. There might be two reasons for this, —the Jews were forbidden to eat of any animal that died with the blood in it, and there could be no security that the blood had been perfectly drained away when it was thus found dead. There might be another and not improbable reason,—all Palestine and Arabia abounded with wolves, foxes, and dogs. They are varieties of animals most of all subject to rabies. The sheep might have been worried by a rabid animal; some of the empoisoned saliva might remain about the wound or fleece, and, the carcase being carelessly handled, hydrophobia might be easily communicated.

### CASTRATION.

One circumstance more may be hinted at before another part of the subject is taken into consideration. Mention has just been made of "calves out of the midst of the stall," and reference is elsewhere made to the ox and the stalled ox. It must not, however, be presumed that the castration of the bull-calf was practised in very early times; for it is the same Hebrew word that is translated indiscriminately ox ‡, ox at plough §, wild ox‖, bullock ¶, bull **, and cattle. It is a generic term: it means the male of the ox genus, or, in some places, and in the last quotation, the ox genus, without distinction of male or female. No word signifying the wether, or castrated sheep, is to be found in the whole of the scriptural history; but there are, however, passages in which it is forbidden to offer any except the perfect animal in sacrifice, and even human beings injured in or deprived of the testicles were forbidden to appear in the Temple. It is probable, therefore, that this method of increasing the tendency to fatness in the sheep, and effecting earlier maturity, and also, to a certain degree, improving the wool, was unknown to the Jews both in earlier and later times. Indeed it is not likely with regard to sheep, that, little as these animals were used for food, a practice should be resorted to, the principal influence of which would be to increase the propensity to fatten early. There is likewise no account of the sheep being stalled for this purpose.

### EWE'S MILK USED AS FOOD.

It may now be proper to enter more fully into the consideration of the nutriment derived from the milk of sheep. It has been seen that, during the antediluvian age, it was thus alone that the sheep contributed to the food of man. The milk and the wool were the only products for which this animal was domesticated, and for which, in some parts of the world, he is even at the present day bred. In proportion, however, as agriculture has improved, the milk of the sheep has ceased to be an article of human sustenance, and has been appropriated to its natural purpose, the food of the lamb.

### QUALITIES OF DIFFERENT MILKS.

Ewe's milk, when freshly drawn, has an appearance very similar to that of the cow, except that it often has a peculiar oiliness about it: it yields however a greater quantity of cream, and forms a very soft kind of butter. In a most learned and useful work on the general properties of milk, by

* Cudworth on the Lord's Supper, p. 14.
† Exod. xxii. 31. ‡ Exod. xxi. 28. § Deut. xxii. 10.
‖ Deut. xiv. 5. ¶ Num. xv. 11. ** Gen. xxxii. 15; Ps. L. 10.

Messrs. Parmentier and Desyeux, the following table is given of the comparative value of the milk of the domesticated animal, with reference to the several uses to which it may be converted:—

| For Butter. | Cheese. | Sugar. | Whey. |
|---|---|---|---|
| The Sheep | Goat | Ass | Ass |
| — Cow | Sheep | Mare | Mare |
| — Goat | Cow | Cow | Cow |
| — Ass | Ass | Goat | Goat |
| — Mare | Mare | Sheep | Sheep |

So that from equal quantities of milk the greatest produce of butter would be obtained from that of the ewe; of cheese from that of the goat; and of sugar from that of the ass: but, at the same time, the sheep is inferior to the goat only, and superior to the cow, in the production of cheese. If, however, ewe's milk excels that of the cow in the quantity of butter yielded, that butter is inferior in quality; it is less solid; it has an unpleasant oily taste, and it soon becomes rancid. On this account, probably, there are few places in which mention is made of ewe's butter as an article of food, and there is no recorded instance of its having been an article of commerce *.

### CHEESE FROM EWE'S MILK.

Ewe's milk was used in the manufacture of cheese many centuries before there is any record of this article of human sustenance being derived from the milk of the cow. Ewe-milk cheese was often made in the early times on a large scale, and was a very material and valued article of food. Butter is frequently spoken of in the sacred scriptures, but it is the opinion of the best commentators that, during the first period of the Jewish history, the word so translated means the caseous and not the oleaginous product of milk. In one passage, where the mechanism described is too plain to be mistaken, the proper translation is given, and that in the most ancient book in the world, "Hast thou not poured me out like milk, and curdled me like cheese †." There is much reason to believe that this was the product of the sheep, for such was the cheese spoken of by other writers of a remote age; and the "butter of kine," mentioned in a later period of Jewish record, would seem to be a delicacy of rare occurrence, promised as the reward of obedience.

### THE DAIRY OF POLYPHEMUS.

Homer, who flourished 900 years before the Christian æra, describes the cave of Polyphemus as it appeared to Ulysses and his companions. It is the earliest record of the process of making ewe-milk cheese and of sheep-management generally, and therefore it is given here at some length. Ulysses is speaking.

> Around the grot we gaze, and all we view,
> In order ranged, our admiration drew:
> The bending shelves with loads of cheeses pressed,
> The folded flocks each separate from the rest.
> (The larger here, and there the lesser lambs,
> The new-fall'n young here bleating for their dams,
> The kid distinguished from the lambkin lies):
> The cavern echoes with responsive cries.

The monster now approaches, bringing home the rest of the ewes.

> Now driven before him through the arching rock
> Come tumbling, heaps on heaps, the unnumber'd flock;
> Big-udder'd ewes, and goats of female kind.
> The males were penn'd in outward courts behind.

* Rees's Cyclopædia, Art. Milk.

† Job x. 10.

Having driven them all into the cave, he closes the door, and commences his evening occupation.

He next betakes him to his evening cares,
And, sitting down, to milk his ewes prepares:
Of half their udders eases first the dams,
Then to the mother's teats submits the lambs.
Half the white stream to hardening cheese he press'd,
And high in wicker baskets heaped: the rest
Reserved in bowls, supplied the mighty feast *.

Euripides and Theocritus speak of cheese, but never of butter. Aristotle gives several directions respecting the manufacture of cheese, but says nothing of butter: in fact it was not known to the early or even the later Greeks. St. Paul, in his Epistle to the Corinthians, speaks of the milk or the product of the milk of the ewes being eaten by the Greeks in his time,—"Who planteth a vineyard, and eateth not of the fruit thereof? or who feedeth a flock, and eateth not of the milk of the flock? †"

### VIRGIL'S MANUFACTURE OF CHEESE.

Nearly 900 years after the time of Homer, Virgil speaks of circumstances connected with the manufacture of cheese from ewe's milk, but he says not a word of that which may be obtained from the milk of the cow.

Some when the kids their dams too deeply drain,
With gags and muzzles their soft mouths restrain.
Their morning meal the peasants press at night,
Their evening meal before the rising light.
To market bear, or sparingly them steep
With seasoning salt, and stored for winter keep ‡.

### ARAB MANUFACTURE OF EWE-MILK BUTTER AND CHEESE.

Mr. Burckhardt gives the following account of the manufacture of butter from ewe's and goat's milk by the Syrian Arabs. "The sheep and goats are milked during the three spring months, morning and evening. They are sent out to pasture before sun-rise, while the lambs or kids remain in or near the camp. About ten o'clock the herd returns, and the lambs are allowed to satiate themselves, after which the ewes belonging to each tent are tied to a long cord, and milked one after another. When a ewe is feeble in health her milk is left wholly for the lamb. The same process occurs at sun-set. From a hundred ewes or goats (the milk of which is always mixed together) the Arabs expect, in common years, about eight lbs. of butter per day, or about seven cwt. in the three spring months. What the Arab's family does not use is sold to the peasants or town's people. The male lambs or kids are sold or slaughtered except two or three which the Arabs keep for breeding. In years of scarcity both sheep and goats prove altogether barren. The Aeneses shear their sheep once a-year near the end of spring. They usually sell the whole of the wool before the sheep are shorn, at so much per 100 sheep §."

Several travellers describe the same process among the Bedouins and Moors of Barbary, and which probably, as with regard to every thing else concerning them, does not differ much from the ancient custom. "Their method of making butter is by putting the milk or cream into a goat-skin, turned inside out, which they suspend from one side of the tent to the other,

* Pope's translation of the Odyssey, lib. ix.
† 1 Cor. ix. 7. ‡ Georg. III. Dryden's Translation.
§ Notes on the Bedouins, p. 114.

and then passing it to and fro in one uniform direction, they quickly occasion a separation of the unctuous and wheyey parts *."

"The butter of the Moors in the empire of Morocco, which is bad, is made by putting the milk into a skin, and shaking it until the butter separates from it †."

Hasselquist, speaking of an encampment of the Arabs, which he found not far from Tiberias, on the foot of the mountain or hill on which Christ preached his sermon, says, "They make butter in a leathern bag hung on three poles erected for the purpose in the form of a cone, and drawn to and fro by two women ‡."

In the Levant they tread upon the skins with their feet. Does this throw any light on a passage in Job, who, when speaking of his former prosperity, says, "I washed my steps with butter, and the rock poured me out rivers of oil §?" He or his servants were so constantly employed in manufacturing butter from the milk which his innumerable flocks yielded, that the rocks or broad stones on which the skins were placed, might be said to pour out rivers of oily matter, and their feet were washed in the semi-fluid butter, for it resembled a kind of concrete oil more than anything else.

There are few of the modern Arabs who, at the present day, use or know the value of the milk of the cow. To this purpose is the testimony of an intelligent traveller. "By the present Arabs the camel's milk is used to drink either alone or mixed with rice and flour, and either sweet or sour; the butter is made of goat or sheep's milk. It is put into a goat's skin, tied to one of the tent poles, and for one or two hours constantly moved backward and forward. The buttery substance then coagulates, the water is poured out, and the butter is put into another skin. If after two days they have collected a certain quantity of butter, they place it over the fire, throw in a handful of *burgoul* (wheat boiled with some leaven and then dried in the sun), and leave it to boil, skimming it carefully. After having boiled for some time, the bourgoul precipitates all the foreign substances, and the butter remains quite clear at the top. The bourgoul that has been thus used is eaten by the children. They seldom make any cheese, but other Arab tribes, and particularly those of Ohl-el-Shemál, manufacture much cheese and sell it to the other tribes ‖."

He adds that the Bedouins eat butter to excess. Whoever can afford such luxury swallows every morning a large cupful of butter before breakfast, and snuffs up as much as he can into his nostrils, while his whole food swims in butter ¶.

The quantity of butter yielded by the flock as reported by Burckhardt, viz. eight pounds a-day by a hundred ewes, or rather more than half a pound per day by each ewe, would scarcely repay the modern dairyman for his trouble and expense. It appears that, whether from the peculiarity of the breed, or faulty management, or the hardships to which the flocks were necessarily subjected by their frequent journeys and occasional deficiency

* Shaw's Travels, p. 168.

† Stewart's Journey to Maquines.

‡ Hasselquist's Travels, p. 159. See also Burder's Oriental Customs, vol. i. p. 138, and Stewart's Travels, vol. ii. p. 35. § Job xxxix. 6.

‖ Burckhardt's Notes on the Bedouins, p. 35.—M. de Brisson, in his singular history of his captivity among the African Arabs, says, that "when the butter which is obtained from sheep and goats, and camel's milk mixed, is churned, they put it into small skins where it acquires a rancid smell, which, according to the taste of these barbarians, greatly enhances its value. The women use it in pomatum for their hair, and without this they would think something deficient in their dress."—p. 91.

¶ Burckhardt's Notes, p. 137.

of food, that neither the sheep nor the kine in former times were very productive of milk. There is a passage in Isaiah illustrative of this. The prophet is speaking of a time of extraordinary plenty, "and it shall come to pass in that day that a man shall nourish a young cow and two sheep, and it shall come to pass that from the abundance of milk that they shall give he shall eat butter*," he shall be able to indulge himself in this favourite luxury of the wandering shepherd. It would seem strange in modern times, if with a cow and two ewes producing milk, he were not able to do this in ordinary years.

The land of Canaan is, on account of its great fertility, spoken of as "flowing with milk and honey †:" and it is predicted of the Messiah by Isaiah, "butter and honey shall he eat ‡." D'Arvieux, being in the camp of the Grand Emir, who lived in much splendour and treated him with great hospitality, was entertained on the first morning with little loaves, honey, newly-churned butter, and cream more delicate than he had ever seen §. In another place he says, one of the principal articles with which the Arabs regale themselves at breakfast is new butter mingled with honey. He adds, that "although these do not seem to suit very well, experience teaches that it is no bad mixture, nor disagreeable in its taste if one is ever so little accustomed to it ‖."

### MANUFACTURE OF EWE-MILK CHEESE IN BRITAIN.

Until a century or two ago, the manufacture of ewe-milk cheese was common in most parts of England. Mr. Culley says that it used to be a general practice through Northumberland to milk the ewes, after the lambs were weaned, for six, eight, or ten weeks; and from this milk great quantities of cheese were made, which sold for about 3*d.* per lb. when kept to three years old. It was exceedingly pungent, and on that account some persons preferred it to cheese made from the milk of the cow ¶.

In some parts of Wales, the ewes still continue to be milked. It used to be particularly the case in the lower part of Glamorganshire; the milk was mixed with that of the dairy, and made a palatable tart cheese **.

In Scotland it was the universal practice, and still remains so in some parts of the Highlands, nor will the memory of it be erased, nor the custom quite cease, while some of the beautiful poetry of these districts remains. The cheese is said to acquire sometimes a smoky flavour, but, where that is not found, it is acknowledged to have a rich taste, with a not unpleasant tartness. The editor of the Encyclopædia Edinensis says, that it digests more readily than that which has been made from cow's milk, but is less nutritive. He adds, that goat's milk is more easily digested, but is also less nourishing, than either ††.

* Isaiah vii. 21, 22.

† Joshua v. 6. It is a proverbial expression denoting plants. So Euripides, speaking of a fertile country, says, that "it flows with milk and wine and the nectar of bees." —Bacch. Ἐπεί. v. 8.—So Ovid,

> "New streams of milk, new streams of nectar flowed,
> And from the oak the yellow honey dropped."

—Metamorph. I. v. 111. See also Homer's Iliad, IX. v. 141, and Burder's Oriental Literature, vol. i. p. 110.

‡ Isaiah vii. 15. § Voyage dans Palestine, p. 24.

‖ Voyage dans Palestine, p. 197; Harmer's Observations, vol. i. p. 291.

¶ Report of Northumberland. ** Lloyd and Turner's Report.

†† Brewster's Encyclopædia, Art. Cheese.—One of the best accounts of this system of ewe-milking in the north is contained in a 'Letter on Sheep-Husbandry in the North, by Mr. Herbert,' in that useful periodical the 'British Farmer's Magazine,' November, 1830. "It appears to have been the pretty general practice forty years ago, to milk the ewe flocks, and either make ewe cheese, or mix and churn it with that of the cows, and

In Ireland the practice is as common as in any part of Scotland, and there, probably from want of cleanliness, the milk has a sharper and more smoky taste.

### OBJECTIONS TO THE SYSTEM OF EWE-MILKING.

The milking of the ewes and the manufacture of this kind of cheese has now deservedly got into disuse in all except a very few districts. Barnaby Googe was the first and almost the only one of the old agricultural writers who had sufficient good sense to perceive the absurdity and mischief of it, where good husbandry, in other respects, prevailed. His condemnation of it is short, but pithy. "In the mean time you must not deale with the milking of ewes, so shall you have them to beare the more wooll, and bring the more lambes*."

As for the old practice of commencing the ewe-milking before the lamb was weaned, and thus stealing a portion of the nutriment, rarely or never too abundant, which nature had designed for the young one, it is too absurd, as well as palpably injurious, to merit serious refutation. Now that the value of the wool and the flesh of the sheep is so much increased, it is received as a principle, admitting of no exception, that the lamb should be abundantly supplied with food. If the fleece is to be good, and especially if the animal is to be brought to quick maturity,—if these are now the acknowledged objects of sheep husbandry, the lamb must not be stinted and starved when young. "I don't know," said an experienced farmer to Mr. Marshall, who was asking him by what means he brought his young sheep to so high a state of condition, "I don't know,—they were lambed fat, and they have been fat ever since; though I believe that I have kept them as well as I could keep them†." It is an easy thing to keep young sheep in good condition when they have not been neglected at first; but exceedingly difficult, if they have been once *let down*, ever to make them fat again, or, indeed, scarcely worth keeping‡.

The Spaniards, with all their bad management in other respects, appear

some of the small farmers are said to follow it to this day. The milking, which was performed every morning and evening, chiefly by women and children, commenced the day after the lambs were taken from the ewes, and continued till about the middle of September, when the ewes were dried off, and well fed preparatory to their receiving the ram. They are said to have yielded from a pint to a pint and three quarters, and some a quart per day. They were milked in little stalls made for the purpose, and are said to have set their legs with as much firmness as a gentle milch cow. Some of the milkers would milk twenty-five of them in an hour." Certainly this is the least objectionable mode of ewe-milking: the lambs, at least, were not stinted and starved.

* Barnaby Googe's Art and Trade of Husbandrie, p. 134.

† Marshall's Rur. Econ. Midl. Counties, vol. i. p. 326.

‡ A writer in the Farmer's Magazine for 1807, p. 434, gives a ludicrous account of this species of ewe-milking. "Care is taken to stint the lambs (this is indeed a very appropriate word, both as it regards their present nutriment and their future growth and value) by milking the ewes every evening before the lambs are admitted to them. This is a scene which I well remember to have witnessed more than 30 years ago, when a boy at school in Perthshire. The maids purposely delayed it until after sunset, that they might have the assistance of their sweethearts, the unmarried ploughmen, after they had pulled their stated number of back loads of thistles. The ewes were driven in a body into a *bught* (or small fold), whence they were taken one by one as wanted to be milked. It was then that the swain's assistance was of use. He dragged the reluctant ewe from the bught, and held her by the horns, while the maid going behind her, abstracted perhaps two or three gills from her udder. Although a few minutes were usually sufficient for doing this, yet it was seldom performed without something else being added by the ewe to the contents of the pail. Although much of this was skimmed off by the damsel with her fingers, yet, together with the yolk and grease from her hands, might it not somewhat contribute to impart that aromatic, pungent taste, by which ewe-milk cheese then was, and now is, distinguished?"

to be fully aware of the necessity of keeping the lamb well, in order to insure a fine and plentiful fleece. Every lamb in the migrating flocks has, besides his natural mother, a foster one; and for this purpose a sufficient number, or probably half of the lambs, are quickly weaned and destroyed.

As for the milking after the weaning of the lambs, there is not so much inconvenience or mischief from the struggles of the ewe, for she feels relieved by the occasional abstraction of the milk with which her udder is overloaded, and soon begins to submit to the operation with tolerable quietness: but there are still insuperable objections to the practice. The lamb must be weaned early in the season, or little profit will be derived from the milk of the ewe; and for the sake of this early weaning, the time of lambing must be contrived to be as early as possible,—in the depth of winter, or before the winter has scarcely passed,—and then, some of the ewes, and more of the lambs, will perish by cold. The lamb must also be taken from the mother at a time when her milk is necessary to him; when he has not yet learned, or has not sufficient strength to obtain nourishment enough from other sources for the full development of his form and distinguishing qualities; and more will ultimately be lost by his diminished value, or by the expense afterwards incurred to get him into saleable condition, than many times the quantity of milk obtained from the dam would repay. The mischief, however, is not confined to the lambs, for when this drain on the mother is protracted beyond the period that nature designs, some other produce that she was intended to yield, and probably a more profitable one, must be proportionably diminished. That which should have increased the weight of the fleece, or of the carcase, or given her a disposition to improve, or brought her regularly and effectually into season for impregnation, or given her strength to yean a full-grown and healthy lamb, has been gradually abstracted in the milk. It used to be observed, even at the time when this practice was most common, that he who followed it up too closely was sure to have fewer lambs, and smaller, and leaner, and eventually of less value; his cast ewes were more out of condition, and more difficult to be prepared for the butcher; and, in the following spring, he had far more barren ewes than his neighbour, who either did not pursue this system to so great an extent, or did not pursue it at all *.

Mr. W. Hogg, when treating on the Flesh-fly or Maggot in Sheep, has an observation that deserves more attention than has been paid to it. He had been saying that a peculiar fetid smell accompanied not only diarrhœa, but the discharge of healthy fæces; that this lodged among the wool above the anus and round the root of the tail, and that it was within the influence of this odour that the fly always deposited its eggs at the beginning of its appearance. He adds, "nothing can be more dangerous than for the ewe-milker to lay hold of the wool with her wet hand, which she is often obliged to do for the purpose of keeping the ewe steady above the pail †." At the close of the season the flies attack the sheep with greater fury, and alight on any part that appears to be fit for their purpose; but the time of mischief is then short,—whereas the ewe-milker, by placing her hand wet, and impregnated with the odour proceeding from the flanks and udders and tail of the animal on various other parts of him, hastens the period of mischief, and probably increases it tenfold.

* Little on Mountain Sheep, p. 64.
† Prize Essays and Transactions of the Highland Society, vol. i. p. 328.

### THE CIRCUMSTANCES UNDER WHICH IT MAY BE ALLOWED.

At weaning time, however, the ewes are occasionally inconvenienced by the fulness of the udder,—local inflammation—the same disease that would be called garget in the cow—ensues: there is enlargement of the udder or of one of the teats, or serious and spreading ulceration of the udder generally. To prevent this, Mr. Parkinson, having kept the ewes for a day and a night after the lambs were taken from them, has them all milked, and a good cheese made of the milk. He adds, "before I adopted this practice, the bag often festered, and some of them had the garget, and lost part of the udder—one pap, or even both. In two days after I had the ewes got up again, and a part of the milk drawn from those that appeared to have too much. Some few of the ewes may want milking a third, or even a fourth time. This method has a great tendency to make the ewes fatten quicker: for, when their udders are full of milk, and it is not drawn, it causes them great pain; and at times destroys the constitution of a good ewe, as the best nurses are the most frequently full of milk *." This may be advisable with regard to the ewes whose udders are really inflamed, or with regard to all, if garget seems to be spreading among the flock, or there appears to be a general tendency to inflammation among them; but, as a usual practice at weaning time, it is scarcely to be recommended. As to the cheese, few would make it, and fewer still would be disposed to eat it, if there were much disease of the udder.

### THE CUSTOM IN ICELAND.

In some other countries the system of ewe-milking is pursued to a more absurd and injurious extent. The ewes are milked every night; and not satisfied with what has been obtained at the first milking, every ewe is caught a second time, and the little which she had kept back for her young one, and which, after her first liberation, she had suffered to descend into the bag, is drawn from her. What is to become of the lamb that is afterwards to toil in vain for nourishment,—or of the ewe, whose strength and constitution are nightly so taxed to provide a small and inadequate portion of milk for her young one,—does not enter into their calculation, When such a practice is pursued, it is no wonder that the Icelandic sheep are diminutive in size; and that their fine wool is mixed with so much that is coarse and almost worthless †.

### FRENCH EWE-MILK CHEESE.

The French seem to adhere as obstinately as any far less civilized people to this antiquated system of sheep husbandry. Ewe-milk cheese is become so much an article of profitable commerce, that the manufacture of it will not soon be relinquished.

A kind of cheese in high request, called the Sassenage cheese, is made of the milk of cows, sheep and goats, mixed together.

In the department of Les Basses Pyrénées, a considerable quantity, said to be peculiarly well-flavoured, is manufactured from ewes' milk alone; but for this purpose the lambs are weaned as early as March: they are, however, generally dropped before Christmas.

The little cheeses in the neighbourhood of Montpelier are made entirely of ewe's milk, stolen from them during the latter period of their

* Parkinson on Live Stock, vol. i. p. 293.
† Hooker's Tour in Iceland, p. 144.

suckling their lambs. The little ones are separated from their mothers every night, and do not return to them until the noon of the following day, after the ewes have been milked on their return from pasture. This is cruel work, and would be highly injudicious management too, if the system of husbandry or the habits of the country permitted the farmer to calculate on any tolerable profit either on the wool or the carcase of his sheep. A flock of four hundred ewes will give six or seven dozen of these cheeses every day until the beginning of June, when they are no longer milked,—as well because *they may not be too much weakened*, as that they may be ready for breeding early in the autumn.

The most celebrated of these productions is the Rochfort cheese, with an account of which this history of ewe's milk shall conclude. It is either made of pure ewe's milk, or by some persons a portion of goat's milk is added. The sheep are pastured all the year on the barren mountains in the neighbourhood, and no peculiarity attends the management of them, except that a considerable quantity of salt is given, which is supposed to impart a certain quality to their milk, but the real effect of which probably is to increase partly their appetite and more their thirst, and thus dispose them to yield a greater quantity of milk. The curdling of the milk is effected in the usual manner, especial care being taken that the rennet has not contracted any unpleasant flavour or smell. When the product has been properly pressed, it is carried to the cheese-room and placed on boards to dry, and, in order to prevent it from cracking, it is tightly bound in a large cloth.

Having become tolerably dry, it is carried to the *caves*,* where, on two successive mornings, it is sprinkled on both sides with fine salt. It is then rubbed with a coarse cloth, and on the following day well scraped with a knife. The parings are made into a round cheese, and consumed in the neighbourhood. Eight or ten of the cheeses are then piled on each other, and left for fifteen days; at the end of which time they are covered with mouldiness six inches in length. This is scraped off, and the cheeses ranged on the shelves as before. At the expiration of another fifteen days they are again cleaned from the mould, and this is repeated for two months, or until the cheeses gradually change from a white to a green and red colour, with blue or green veins running through the whole of their substance. The loss which takes places in all these manipulations is so great, that 100 lbs. of milk will not yield more than 20 lbs. of cheese.

The butter which is procured from the cream of this milk is said to be finely flavoured; but, like all other butter from ewe's milk, it is semi-fluid, and is sold under the name of Rochfort cream †.

* In the middle of Rochfort there is a deep valley, terminating in a cul-de-sac, and surrounded by a range of narrow peaked rocks, hollowed into numerous caverns. The rays of the sun do not penetrate into this valley more than a few hours during the longest days of summer. On the sides of these caves shelves are constructed for the cheeses. In different parts of the rock there are certain clefts or cracks, through which a cold wind blows sufficiently strong to extinguish a candle if brought within three feet of them. It is to the coldness of this wind that the property which these caves possess of bringing the Rochfort cheese to so much perfection is justly attributed. There is a considerable difference in the temperature of these caves, according to the degree in which this wind finds its way into and through them. M. Mascorelle found that the temperature of these caves was 16 degrees (Fah.) below that of the external air when he examined them in October. M. Le Sage, in the month of September in a certain year, found that in seven or eight of the caves the air was 15 degrees, and in two others it was 20 degrees colder than without. It is not often that nature presents these advantages for such a purpose, and it would be with much difficulty that they could be obtained artificially.

† Encycl. Méthod., art. Fromage.

## Chapter III.

The Structure of the Skin—Value of the Pelt—Anatomy of the Wool—Difference between Wool and Hair—The first Sheep probably hairy—Gradual change from Hair to Wool—The Yolk—The form of the fibre—The supposed cause of Felting—Microscopic appearance of Hair and Wool—The Discovery of the irregular surface of the Wool—The different appearance of Hair—The properties of Wool—Fineness—The Wool-stapler—The influence of temperature—Pasture—Trueness—Soundness—Softness—The influence of the Yolk, Smearing, Clothing, Soil on this—Elasticity—Colour—The Felting property resumed—The various theories respecting it—Dependent on the curved form and serrated edge of the Wool—Illustrations of it—The different structure of different Wools as relating to Felting—The divisions of Wool—Long—Middle—Short—The operations of Carding and Combing.*

In order that the peculiar qualities and relative value of the different breeds of sheep may be duly estimated, when more precise descriptions of that animal begin to be found in the records of various countries, and in the narrations of travellers and the works of agriculturists, it will be advantageous to devote a few pages to the consideration of the structure, and varieties, and uses of wool; and especially as, during too long a period, the importance of the sheep, as contributing to human sustenance, was not fairly appreciated, but the attention of the sheep-master was principally and almost exclusively directed to the fleece.

### THE STRUCTURE OF THE SKIN.

The skin of the sheep, and of animals generally, is composed of three textures. Externally is the *cuticle*, or *scarf-skin*, which is thin, tough, devoid of feeling, and pierced by innumerable minute holes through which pass the fibres of the wool and the insensible perspiration. It seems to be of a scaly texture; but this is not so evident in the sheep as in many other animals, on account of a peculiar substance, the yolk, which is placed on it, to nourish and protect the roots of the wool. It is, however, plainly enough to be seen in the scab, and other cutaneous eruptions to which the sheep is liable.

Below this is the *rete mucosum*, a soft structure; its fibres having scarcely more consistence than mucilage, and being with great difficulty separated from the skin beneath. This seems to be placed as a defence to the terminations of the blood-vessels and nerves of the skin, and these are, in a manner, enveloped and covered by it. The colour of the skin, and probably that of the hair or wool also, is determined by the rete mucosum; or, at least, the hair and wool are of the same colour as this substance.

Beneath is the *cutis*, or *true skin*, composed of innumerable minute fibres crossing each other in every direction; highly elastic, in order to fit closely to the parts beneath, and to yield to the various motions of the body; and

* The author begs to acknowledge the great assistance he has received in the composition of this chapter. He particularly refers to Messrs. Hubbard and Goodman of Leeds, and to an unknown but valuable correspondent at Bradford. To Mr. Thomas Plint, also, of Leeds, he is under obligations which he shall never forget.

After all, however, an author has his own views, and will pursue his own course; and he must abide the consequence. Whatever is confirmed by the experience of the sheep-breeder and the manufacturer, or, in spite of themselves, overturns their long-cherished prejudices and errors, they may divide as they please among him and his friends—that which will not bear the test of examination and experience, let them place to the author's score.

dense and firm in its structure, that it may resist external injury. Blood-vessels and nerves, countless in number, pierce it, and appear on its surface under the form of *papillæ*, or minute eminences, while, through thousands of little orifices, the exhalant absorbents pour out the superfluous or redundant fluid. The true skin is composed principally or almost entirely of gelatine, so that, although it may be dissolved by long-continued boiling, it is insoluble in water at the common temperature. This organization seems to have been given to it, not only for the sake of its preservation while on the living animal, but that it may afterwards become useful to man.

The substance of the hide combines with the tanning principle, and is converted into leather.

The skin of the sheep seldom undergoes the full process of tanning, but it is prepared in a peculiar way, and used as a commoner sort of binding for books, or it is manufactured into parchment, and thus on account of its durable nature, becomes most valuable, as connected with the disposal and security of our property. Some of the foreign lambskins are much sought after, as a species of ornamental clothing, as well as on account of their comfort and warmth, and are prepared with the wool remaining on them.

### THE VALUE OF THE PELT.

The inhabitants of the Ukraine and Podoli, as soon as the lamb is dropped (which comes into the world with a pretty wavy skin, even without the assistance of art), sew it up in a sort of coarse linen shirt, so as to keep up a constant gentle pressure on the wool, pouring warm water over it every day, in order to make it soft and sleek. They slacken the bandage a little from time to time, as the animal increases in size, but still keep it tight enough to lay the wool in beautiful glossy ringlets, and thereby produce a delicate skin in great request in other countries for lining clothes and morning gowns. By this process the fine soft wool of the young lamb takes a beautiful arrangement; and the animal is killed younger or older according to the material intended to be produced, whether with a short glossy nap, like satin, fit only for delicate linings, or a warm thick fur for winter clothing*.

The Boucharian Tartars carry this refinement to a greater extent. They will not kill the female, for they look to her for the continuance of their flocks; but a great number of the male lambs are destroyed as soon as they are dropped. The wavy curls of these fleeces are sometimes remarkably beautiful, the richest damask scarcely exceeding them. They are of a black, blue, or silver-grey colour; the first of which, when thoroughly glossy, are most highly esteemed.

In some districts these fine and valuable furs—they partake more of the nature and appearance of fur than of wool—are produced by other means: the mother is slaughtered a little before her time of pregnancy would have expired, and the little one taken from the womb and destroyed while the carcase is still reeking. The short glossy fur, lying close to the pelt, is said to be more beautiful than any that could have been obtained from the same animal after birth †.

Bell, in his Travels in Russia in 1750, gives a similar account:—" At Astrachan they have great quantities of lamb-skins, grey and black, and some waved, others curled, all natural and very pretty, having a fine gloss, particularly the waved, which at a distance appear like the richest watered tabby. They are much esteemed, and are extensively used for the lining of coats and the turning up of caps in Russia and Persia and other parts. The

* Dr. Anderson on the Russian and Tartarian Sheep, p. 20. † Ibid. p. 54.

best of these are brought from Boucharia, Chiva, and the countries adjacent, and are taken out of the ewe's belly after she has been killed, or the lamb is killed directly after it is lambed; for such a skin is equal in value to the sheep. The Kalmucks and other Tartars, who inhabit the desert in the neighbourhood of Astrachan, have also lamb-skins, which are applied to the same purposes; but the wool of these being rougher and more hairy, they are far inferior to those of Boucharia or Chiva, both in gloss and beauty, as also in dressing, and consequently in value: I have known one single lamb-skin of Boucharia sold for five or six shillings sterling, when one of these would not yield two shillings."

Professor M'Culloch says that the value of lamb-skins varies according to the fineness, brilliancy, and colour of the wool. Black lamb-skins are more generally esteemed than those of any other colour. Some English lamb-skins, perfectly fine and white, and taken from the Anglo-Merino breed, are in considerable estimation. The greater part, however, come from abroad, and the importation of them is immense, having amounted on an average of 1831 and 1832, to 2,365,635, four-fifths of which were supplied by Italy. They are mostly used in the manufacture of gloves, 120 skins producing, on the average, 18 dozen pairs of gloves*.

On the skin of most animals, and intended somewhat for ornament, and the better distinction of species, but more for the warmth and comfort of the individual, is placed a covering of feathers, fur, hair, or wool. They are all essentially the same in composition. They are made up of an animal substance resembling coagulated albumen; an oily matter of various hues, according to the colour of the feather or the hair; and sulphur, silica, carbonate and phosphate of lime, and oxides of iron and manganese †.

The growth of the feather is different from that of the hair or wool. A small hollow cone first protrudes—the germ of the future quill; it increases in length and in bulk for a certain time, and then it opens at the apex, and the shaft of the feather pushes forward, with the filaments on either side of it; and these gradually unfold themselves and increase in size, yet rarely in number, until the feather is perfectly formed. The hair emerges from the skin of the same substance and bulk that it will ever be, and it increases in length only by the protrusion of fresh portions which push the others before them ‡.

### ANATOMY OF THE WOOL.

In the fatty and cellular substance immediately beneath the cutis or true skin—some say imbedded in the true skin—there are numerous minute vascular bulbs. They arise from the cellular texture, and penetrate into the true skin; they consist of a double membrane, the outer one of which stops at the pore, or minute aperture in the skin, and between the two membranes a vascular texture has been traced. From the interior and centre of the inner membrane there proceeds a minute eminence, or papilla, which, surrounded by the membrane, projects into and through the cutis, while numerous fine filaments unite to form or to surround a seeming pro-

* M'Culloch's Dictionary, art. Gloves, Lambs, Sheep, Skins.

† Henry's Chemistry, vol. ii. p. 487.

‡ Dr. Anderson well illustrates this by a circumstance that is familiar to every shepherd: "About the month of November," says he, "most of the farmers in the south of Scotland cover the whole surface of the body of their sheep with a composition of tar and butter in certain proportions. This makes a black mark, which remains quite perceptible as long as the wool remains upon the sheep: but this mark gradually rises from the skin as the wool grows, so that at shearing time it is found to be nearly in the middle, the under part of the wool which had grown during the winter and spring being of a pure white below this black ring."—Anderson on Sheep, p. 115.

longation of the original papilla. In this way it gradually penetrates the cutis, and the rete mucosum, from which, as has been already observed, it takes its colour, and then, either pushing its way through the cuticle, the displaced portion of which falls off in the form of scurf, or carrying a part of the cuticle with it as a kind of sheath, it appears under the form and character of hair.

Whether it is a perfectly solid body, as some, describing its appearance when subjected to the power of the microscope, have affirmed *, or whether it consists of a hard exterior tube with a medulla or pith within †, has not been demonstratively proved. It is extremely difficult so to bring the hair under the power of a lens with a focus on not more than one-twentieth or one-thirtieth of an inch, as to obtain a knowledge of its internal structure. Those who are most accustomed to the use of the microscope are scarcely yet agreed as to the external form of the hair. That which is confidently affirmed of it by some, and which would beautifully explain several phenomena attending it, is as confidently denied by others. It will not, then, occasion much surprise if difference of opinion exists as to its internal conformation‡.

The fibrous structure of the hair is sufficiently evident: the gossamer filaments of the albuminous gluey substance within the inner membrane at the root have been seen converging in order to form the stump; and when the hair or wool has been diseased or decaying, or dead, it has been observed to split into numerous fibres at its point §. In this it bears an

* Hooke's Micrographia, vol. iii. fig. 2; Young's Nat. Phil., vol. ii. p. 190.

† Leuwenhoeck in Phil. Trans.

‡ It is amusing to compare the different testimony on this point given by those who have observed the hair, assisted by the most powerful lenses, who were skilled in the use of the instrument, and who could have no intention to deceive. Leuwenhoeck and Hooke published their microscopical observations about the same time. "The whole hair," says the first of these philosophers, "consists of little strings, whereof there were about a thousand in one hair, fewer or more, according to the thickness of the hair. Whether these strings are hollow, like so many pipes or vessels, I cannot possibly say; but it seemeth to me that they are, so that I conceive we may not unfitly compare the clods of the hair," (he had been speaking of irregularities on the surface of the hair,) "consisting of the aforesaid irregular particles, to the bark of a tree, and the little strings which compose that part of the hair within the clods, to the pipes which make the wood. In larger hairs, as the bristles of a hog, these hairs appear to be hollow. The whole root, except the cuticle, consists of little strings, which I suppose to be veins or vessels; and I have shown the root of a hair with all its fibres so plainly, as if before our eyes we had seen lying a common tree with all its roots, except that these fibres in the root of a hair were all of one thickness."—Philosophical Transactions, 1678, vol. xii. p. 1004.

On the contrary, Hooke gives the following account of the hair:—"They," the hairs of his head, "were for the most part cylindrical. Some of them were somewhat prismatical, but generally they were nearly round; they were all along, from end to end, transparent, although not very clear; the end nearest the root appearing like a black transparent piece of horn. The roots of the horn were smooth, tapering inwards almost like a parsnip; but I could not find that it had any filaments or any vessels like the fibres of a plant. The top, when split, which is common in long hairs, appeared like the end of a stick beaten until it be all frittered, there being sometimes half a score splinters or more. They were all, so far as I was able to find, solid cylindrical bodies, not pervious, like a cane or bulrush; nor could I find that they had any pith, or distinction of rind or the like, as I have observed in horses' hair, deer's hair, and the bristles of a cat. Even the bristle of a hog was a large transparent, horny substance, without the least appearance of pores or holes in it. Although I caused the light to fall in all the various ways I could think of, or that was likely to make the pores appear, if there had been any, I was not able to discover any; those parts that appeared to be pores in one position of the light, I could find a manifest reflection to be cast from them in another."—Micrographia, p. 156.

§ Bakewell's remarks on this point of the anatomy of the hair deserve to be quoted. "Hair is frequently observed to split at its points into distinct fibres—a division has also sometimes been seen in the hair of wool. This seems to prove that they are formed of distinct long filaments uniting in one thread or hair. In large hairs I have discerned

evident analogy to the structure of the nail of the human being, the hoof of the horse, and the horn of the bullock.

Like them it is vascular; although it grows as they do, principally by additions from the root, it is capable of deriving nourishment from vessels belonging to its pulp, which seem to accompany it to a considerable distance from the root, if not through its whole extent. The Plica Polonica, a disease whose existence is doubted by some, but of the occasional occurrence of which there is abundant testimony, completely establishes the vascularity of the hair; for it is an enlargement of the bulk of the hair itself: an enlargement of the individual hairs, so much so, as, in some cases, to permit the passage of red blood, for the hair will bleed when divided by the scissors *.

The staunchest advocate for the solidity of the hair of the human being, and whose observations have just been quoted in a note, acknowledges that in the hair of the horse and the deer he could trace a plain distinction of rind and pulp; he also has seen the fibres of which the general substance of the hair was made up. Bakewell has divided a hair into numerous fibres; Leuwenhoeck believed that he had seen hollows in these fibres, proving them to be tubes and vessels. The weight of evidence clearly favours the supposition that it consists of an external rind or tube, and an internal pulp or collection of fibres; the pulp or pith being found in its young state, or near the root; and the fibres, like those of a tree, or the branch of a tree, occupying and forming the substance of the hair. The hair however possesses the principle of vitality to a very slight extent; it is formed of those materials which are comparatively little subject to decomposition, and therefore it will preserve its form and properties for a long and indefinite period †.

### WOOL-BEARING ANIMALS.

Authors have seemed to imagine that the production of wool was confined to the sheep; practical men, however, know that there is a numerous list of animals on whom, at some season of the year at least, wool is found. It used to be considered as one distinction between the goat and the sheep that the former was covered with hair and the latter principally with wool. The under hair of some goats, however, is not only finer than the fleece of any sheep, but it occasionally has the crisped appearance of wool. It is, in fact, wool—of different qualities in different breeds; in some rivalling or excelling that of the sheep, but in others so coarse as to be of use for the lists and edges of cloth alone.

On many of the undomesticated species of deer a portion of wool is found at the roots of the hair. It is so in the moose-deer, or elk, although not in any great quantities; on the wapiti deer it forms a thick covering; and it is plainly perceptible on some parts of the hide of the British red deer in the winter months; on the fallow deer it is more abundant; on the axis deer it has not been detected.

On some foreign breeds of oxen, as the yak of Tartary and the ox of

a number of divisions from the root to the point. In one hair I distinctly perceived fifteen of these divisions or fibres lying parallel to each other, and in some of the fibres a further subdivision was distinguishable. Probably these subdivisions were each composed of others still smaller, which the limited power of our instruments may prevent us from discovering. If such be the structure of the hair of some animals, it is at least probable that the hair of all others may have a similar conformation, although the fibres of which they are composed may be too minute, or adhere too firmly together to permit us to separate or distinguish them."—Bakewell of Wakefield, Observations on Wool, p. 125.

* Good's Study of Nature, vol. v. p. 678. † Bostock's Physiology, vol. i. p. 50.

Hudson's Bay, some fine and valuable wool is produced; on the Brahmin bull and cow it is sought for in vain.

The gnoo, a species of intermediate genus between the antelope and the ox, has, mixed with and filling up the interstices between the hair, a considerable quantity of wool, which is cast off in large masses in the spring. This is particularly observable in the pair of gnoos belonging to the Zoological Society of London.

The camel has, at the base of its long hair, a quantity of wool, which, if he were bred and multiplied in the British dominions, would be converted to useful purposes.

Many fur-clad animals bear upon them a variable quantity of wool. The hare, the rabbit, and the beaver, as will hereafter be more distinctly shown, are illustrations of this.

Nor is this mixture of hair and wool confined to the herbivorous animals; the most cursory examination will show it in the sable and the polecat. Some shorter, softer, wavy hair, interlacing with the neighbouring fibres, was found about the mane of a lion bred in confinement, and also on the neck of a tiger; probably extending over the whole of the frame of these animals when, in their native forests, and exposed to varying seasons, they need this double coating. This, perhaps, must not be called wool; but the author discovered, with mingled surprise and pleasure, a considerable quantity of true wool at the base of the external covering of an Italian wolf-dog. Its spiral curls were too distinct and numerous to be for a moment mistaken; and, very soon afterwards, he obtained from a Newfoundland dog, recently imported, and on a bear from Prince Edward's Island, a plentiful under-layer of wool, of the structure and felting properties of which delineations will be given. On the spaniel, the pointer, the hound, the greyhound, and the short-haired terrier, he sought for it in vain, but on one of the Isle of Skye terriers a small quantity was found.

"My opinion," says Mr. Plint, "the result of much thought, is, that with few exceptions, the covering of quadrupeds is a mixture of hair and wool, varying greatly in their proportions to each other. Let us consider them in their native state. They are exposed to the vicissitudes of the seasons, and therefore need a covering at one time to throw off the direct influence of the sun's rays, and at another time to retain the animal warmth, when the surrounding temperature would otherwise rapidly withdraw it. Hair and wool are bad conductors of heat, and admirably adapted for both purposes, and they exist in actual and in relative quantity according to the altered situation and wants of the animal. Thus, in summer, the fleece of the arctic hare is thin, as I believe is that of the argali; in winter, a fine wool fills up the interstices between the hair, and protects the animal from the inclemency of the weather. Here is an admirable provision for the wants of animals generally; but we should stop short of the exact adaptation of the fleece to these wants, if we did not remark how necessary it is that the wool, so indispensable to the retention of the warmth of the animal, should be protected by a coat of long smooth hair. Just imagine the argali or the hare, or, to instance animals of the carnivorous genus, the sable or the polecat, clothed with wool only, and what a miserable plight the poor animal would soon be in!—the fleece a constant impediment to its movements among underwood, if indeed it were not entirely stripped off the back of the animal." There is a great deal of the true philosophy of zoology in these remarks; and what a boundless field for future investigation, the employment of human industry, and the extension of commerce and national wealth is here opened!

### THE EXTERNAL COAT OF THE FIRST SHEEP PROBABLY HAIRY.

From what has been stated of the mixture of hair and wool in the coat of most animals, and the relative situation of these materials, it will not appear improbable that such was the character of the fleece of the primitive sheep. There are, at the present day, varieties of this animal occupying extensive districts that are clothed outwardly with hair of different degrees of fineness and sleekness; and underneath the external coat is a softer and shorter and closer one, that answers to the description of fur according to most travellers, but which really possesses all the characters of wool. In a very considerable proportion of Tartary the sheep are covered with a sleek and silky hair; the flocks of the Boucharian Tartars are all of this character. In the eastern districts of India, in several parts of China, and in many of the regions of Africa, the pelt is protected by hair of a longer, coarser, and more shaggy kind *.

"In the Sahara desert of Africa the sheep are commonly of the height of a doe, and covered with hair like that of a dog; and the Abbé Demanent asserts in his new history of Africa, published at Paris in 1787, that two varieties of sheep are reared in Guinea, one of which is covered with wool, and has a long fat tail, (the fat probably accidental,) while the other is larger, stronger, and covered with shaggy hair, like a goat †."

Dr. Anderson says that he had an opportunity of seeing a night-gown lined with the Boucharian lamb-skin fur, described in page 53, and which, says he, "I find consists of nothing else but hair, without the smallest intermixture of wool ‡."

Sir Joseph Banks once imported three sheep from Spain, "which were sleek and smooth as a horse, and never, in any season," according to the representation of this eminent naturalist, "showed the least signs of wool or down in the most minute quantity §."

Mr. Plint first led the author to doubt the perfect accuracy of these accounts. The careless and superficial manner in which travellers have examined and described the sheep of the countries they visited is well known. These useful animals have scarcely been deemed worthy the tourist's notice; and even the naturalist has not dreamed of finding in this poor beast, common to every country, any thing worthy of record. In addition to this it may be stated, that the naturalist had rarely a definite conception of the difference between hair, and fur, and wool, or of the extent to which they mingled in the covering of almost every animal. It is therefore highly improbable that the sheep, which is now become, by cultivation, in some countries, *par excellence, the wool-bearing animal*, should, in any country, or at any time, have been perfectly destitute of it. Sheep of almost every known variety have occasionally been inmates of the Gardens of the Zoological Society, but there has not been one on which a portion of crisped wool, although occasionally exceedingly small, has not been found at the bottom of the hair ‖.

* Luccock on Wool. † Anderson on Sheep, p. 18.

‡ Bath Society Papers, vol. viii. p. 11.

§ Ibid. p. 12. Dr. Anderson says in another publication, "Last summer a Danish East Indiaman put into Leith Roads on her return home. I went on board to see what curiosities she had, and I there found a very fine sheep, which was covered with a close coat of thick short hair, very smooth and sleek, like the coat of a well-dressed horse, but the hairs rather stiffer, and thicker set on the skin, the colour a fine nut-brown. I was told that it was brought from the island of Madagascar, and that all the sheep found in the island were of the same sort."—American Philosophical Transactions, vol. iv. p. 149.

‖ An argali died at the Gardens of the Society a little while ago, and the author, being then confined by illness, requested a very intelligent and observant friend to examine the proportion of wool which grew among the hair. He reported that there was

In all the regions over which the patriarchs wandered, and extending northward through the greater part of Europe and Asia, the sheep is externally covered with hair, but underneath is a fine short downy wool, from which the hair is easily separated. This is the case with the sheep at the Cape of Good Hope, and also in South America.

In the volume of the American Philosophical Transactions just quoted, the Jamaica sheep is thus described:—"The Jamaica sheep forms a distinct variety, altogether different from any other I have ever seen. The hair is a substance *sui generis*, and is as different from the kemp and stichet hair of Europe as from the long tough hair of the Russians and other hairy breeds. The wool, too, is as different from that of other sheep-wool as the hair; it is finer than any other, not excepting the Shetland breed, although I should suspect that it is scarcely so soft *." It was, however, once asserted of this sheep, that it was altogether devoid of wool; and it has been still more lately and strangely maintained, that British sheep, transported to Jamaica, would speedily lose their woolly coat, and become altogether hairy.

### THE GRADUAL CHANGE FROM HAIR TO WOOL.

The observation of the occasional admixture of wool and hair, and the experience of the superior utility and value of the wool, would probably induce the early shepherds to take serious note of the circumstances that seemed to influence the proportionate quantity of these substances. It would soon be evident that climate and temperature had much to do with this. The argali has been known in Russia from time immemorial, and regarded by many persons as the origin of the various breeds of domesticated sheep. In summer its coat consists of short hair, sleek, and resembling that of a deer; but in winter it is made up of wool mixed with hair, and concealing at its roots a fine woolly down †.

It is probable, that a change, bearing much resemblance to this, would take place in the primitive flocks, corresponding with the change of seasons.

This would naturally suggest the conclusion, that the nature of the coat of the sheep was in some measure dependent on the external temperature; and, that if Providence did not temper the wind to the shorn lamb, it at least suited the defence to the hardship which was to be endured in winter, and the oppressive heat that was to be avoided in summer. Hence probably would follow the experiment, whether, by sheltering from the inclemency of the one season, and the sultriness of the other, a more uniform, and useful, and valuable fleece might not be procured; or, if no direct experiments were instituted, the continual change of pasture which was rendered necessary by the nature of the country and the numerousness of the flocks, and the direction in which the wanderings of the shepherds were performed, from the south to the north until the midst of summer, and from the north to the south until mid-winter, would tend, in some measure, to produce this desired change and improvement in the fleece.

The working of another agent might not escape attention. Both the quantity and the kind of nutriment—the condition in which the sheep are

not a particle of wool. The author was surprised at this, as the argali was described as having a winter coat at least of fine woolly down, and he sent and requested a small portion of the pelt. The hair was long and coarse enough, but at its base was an exceedingly small quantity of crisped wool. There was so little of it that it could scarcely be detected on the pelt, but was clearly seen when a lock of the hair was cut off close to the skin, and held up to the light. This goes far to explain the accounts that have been occasionally given of these perfectly hairy sheep.

* Vol. v. p. 153.

† Anderson on Sheep, p. 9.

kept—have, as will be seen in a thousand instances, much influence in determining the character of the fleece, and in this respect among others.

Wherever these hairy sheep are now found, the management of that animal is in a most disgraceful state; and among the cultivated sheep, and those who are the especial subjects of this work—the British sheep—the remains of this ancient hairy covering exist, to any very great extent, among those alone that are comparatively neglected or abandoned. Kemps or hairs have nearly ceased to deteriorate the fleece of the South Downs, and they are little seen in the Leicesters, the Cotswolds, or the Bamptons*; but they are found on the wilds of Dartmoor, and the mountains of Wales, Westmoreland and Scotland, and, from the perfect abandonment of the Shetland sheep, their fine and silky wool is often mixed with long hairs. Where they have been banished from the fleece, they continue to appear upon the faces and legs, particularly in the Wiltshires, and also in the Norfolks, and to a greater or less degree on the belly of several of the breeds of British and foreign sheep. Here they are of no material consequence, for they do not mingle with the prime part of the wool.

These causes, however, would operate only to a limited extent; a more powerful principle would, at a very early period of sheep-husbandry, be called into action—that which enables the agriculturist not only to modify the character of his flock, but to change it altogether—the magician's wand, by means of which he may summon into life whatever form and mould he pleases—the principle of selection—the fact, that "like will produce like." The early shepherd would therefore select for breeding those animals in which the quantity of hair was smaller than usual, and that of wool correspondingly increased—in which the wool not only afforded warmth in winter, but was becoming a permanent covering; and by steady adherence to this, the character of the fleece would be gradually yet essentially changed. There was a selection, from time to time, of those animals to breed from which bore most wool, until ultimately a breed has been obtained, bearing wool only, or nearly so.

### THE YOLK.

The filament of the wool has scarcely pushed itself through the pore of the skin, than it has to penetrate through another and singular substance, which, from its adhesiveness and colour, is called the YOLK. It is found in greatest quantity about the breast and shoulders—the very parts that produce the best, and healthiest, and most abundant wool—and in proportion as it extends to any considerable degree over other parts the wool is then improved. It differs in quantity in different breeds: it is very abundant on the Merinos; it is sufficiently plentiful on most of the southern breeds, either to assist in the production of the wool, or to defend the sheep from the inclemency of the weather; but in the northern districts, where the cold is more intense, and the yolk of wool is deficient, a substitute for it is sought by smearing the sheep with a mixture of tar and oil or butter. Where there is a deficiency of yolk, the fibre of the wool is dry, and harsh, and weak, and the whole fleece becomes thin and hairy:

* Where hairs are found in the long-woolled fleece they are generally separated in the process of combing; the remaining wool suffers in some degree from the heat of the comb, or the violence with which it is used, but the noyles (or the portion separated by the comb) are very little injured. Even from the short wool, they are removed by the action of the scribbling machine. It is where the kemps are so intermingled, or so numerous, that they cannot be got rid of, that they are most of all injurious, for by their coarseness and want of elasticity they spoil the cloth before it is dyed; or, if not altogether so, there is great difficulty in dyeing it of a good and permanent colour.

where the natural quantity of it is found, the wool is soft, and oily, and plentiful, and strong. Precisely such, in a less degree, is the effect of the salving in suppling, and strengthening, and increasing the quantity of the wool.

It is not the inspissated perspiration of the animal; it is not composed of matter that has been accidentally picked up and that has lodged in the wool; but it is a peculiar secretion from the glands of the skin, destined to be one of the agents in the nourishment of the wool, and, at the same time, by its adhesiveness, to mat the wool together, and form a secure defence from the wet and the cold*.

The medium quantity of yolk on a Hereford, Shropshire, or Sussex sheep, is about half the fleece; and this is the customary allowance to the wool-buyer, if the fleece has been sold without washing†.

A celebrated French chemist, M. Vauquelin, has made various experiments on the composition of the yolk of wool; the result is as follows:—It is composed, 1st, of a soapy matter with a basis of potash, which formed the greater part of it. 2nd, A small quantity of carbonate of potash. 3rd, A perceptible quantity of acetate of potash. 4th, Lime, whose state of combination he was unacquainted with. 5th, An atom of muriate of potash. 6th, An animal oil, to which he attributed the peculiar odour of the yolk; and, in conclusion, he was of opinion that all these materials were essential to the yolk, and not found in it by accident, for he analysed the yolk in a great number of samples, as well Spanish as French, and found them in all ‡.

The yolk being a true soap, soluble in water, it is easy to account for the comparative ease with which the sheep that have the natural proportion of it are washed in a running stream. There is, however, a small quantity of fatty matter in the fleece, which is not in combination with the alkali, and which, remaining attached to the wool, keeps it a little glutinous notwithstanding the most careful washing §.

* Luccock on Sheep, p. 81. † Agricultural Magazine, March, 1833.

‡ Annal. de Chimie, An. xi. No. 141. See also Philosophical Magazine, vol. xix.

§ An annotator on Vauquelin says, with regard to this, although there is nothing new in the practice to the British wool-seller or buyer, that if, "after this washing in running water, soap, of one-twentieth part of the weight of the wool, is dissolved in a sufficient quantity of warm water, and the wool is often immersed in it and the liquid squeezed out, it will be entirely purified from the small quantity of grease which then adhered to it, and will have a softness and degree of clearness which it could not have had without this operation." Another somewhat singular passage is quoted—the reader must form his own opinion respecting it. "The yolk itself, when a little concentrated, has an efficacious action on the portion of grease which is not in a saponaceous state, for I have found that in putting to the wool only the quantity of water necessary to cover it, it scours better, particularly with a little heat, than when it is washed in running water, but I have also found that when wool has remained too long in its own yolk, it swells, splits, and loses its strength.

"Since the solution of the yolk occasions this swelling and splitting of the wool, is it possible that this accident may happen on the sheep's back, particularly in hot, moist seasons, or when they are shut up in folds in which the litter is not often enough removed? Nor would it be impossible that the acrimony of the yolk may occasion an irritation on their skins, and by that means be the cause of some of the disorders to which this organ is liable in these animals, and which mostly happen in hot and dry weather. Fortunately in these seasons they are from time to time exposed to rains, which wash them and carry off at least a portion of this matter: on this subject I cordially agree with those who think that washing sheep in hot and dry weather would be useful to their health and the quality of their wool."

These are questions which deserve attention; but the evidence, so far as it has been hitherto adduced, goes to this point, that the yolk, and its substitute the common salving, have, in a thousand instances, been manifestly beneficial to the sheep and the wool, and in no case been proved to be injurious, and, in cases like these, more regard is to be had to fact than to the most ingenious and plausible theoretical reasoning.

This subject may be summed up in the comprehensive language of Mr. Luccock. "He," the northern sheep-master, after having applied his salving, "finds this dirty coat as indispensably necessary to the good qualities of the fleece as it is to the health of the animal; without it, the wool becomes hairy, thin, and light; with it, the fleece is full, soft, and rich, possesses a sufficient quantity of healthy yellow yolk, and the qualities and condition of the wool are most wonderfully improved. From these circumstances we conclude that the yolk is not only necessary to the production of a valuable fleece, but is the very pabulum of wool. The manner in which the yolk acts upon the wool is not accurately known. Some have considered it as the superabundance of that substance which forms the filament, and which, by some unknown process, while the pile is growing, is consolidated into a transparent mass; while others conclude, perhaps more reasonably, that it is a peculiar secretion which exudes through the skin, and, by intermingling with the pile, renders it soft, pliable, and healthy, affecting it much in the same way as oil does a thong of leather when kept immersed in it and perfectly saturated. In general this substance has been noticed without any particular reference to the breed of the animal, or the qualities of the fleece which it bears; sometimes as perfectly diregarded as the sand and the hay-seed which are accidentally mingled with the pile. Yet the disposition to produce this valuable animal soap is certainly as important as some other characteristics of the sheep, and ought not to be overlooked when we describe their different varieties or select them for our farms."*

### THE DIFFERENCE BETWEEN WOOL AND HAIR.

There is considerable difficulty in describing this. They are essentially the same in chemical composition, and to the unpractised eye they bear much resemblance to each other in appearance. The smallness of the fibre, and its softness and pliability, can scarcely be considered as sufficient distinctive characters; for the hair yielded by some animals is as soft as any silk, while the wool of a few of the favourite breeds of sheep is objected to on account of its harshness. The colour and degree of transparency will not guide the observer; for wool differs in colour on different animals, and different parts of the same animal—at the best it is but a semi-transparent object, and some species of hair are as pervious to light, or as beautifully refract the rays of light, as any wool. The degree also of transparency which wool possesses varies materially with the health and keep of the animal, and numerous other circumstances.

### THE PERIODICAL DECIDENCE OF WOOL AND HAIR.

Wool is distinguished from hair by the manner in which it separates from the animal, and is renewed. Most of those animals whose covering is hair, renew their coat at least once in the year: in the horse it is shed twice—in the spring and the autumn. This is evident enough in the colt, and in the farmer's horse, whose coat is often exposed, almost as much as in a state of nature, to the influence and occasional inclemency of the seasons; but when they are domesticated and stabled, the process is far from being regularly conducted; it appears to be in a manner suspended, but it is, in fact, going on all the year round. In the deer it has its regular period; less so in the ox, and least of all in the dog: but in all of them, when the pulpy substance at the root of the hair ceases to be supplied, and, losing its support, the hair is detached and falls off, the different fibres separate, as it were, one

* Luccock on Wool, pp. 82, 84, 85.

by one. The old hair and the new remain together for a season, and no part of the skin is left at any time bare. The period of the reproduction of the hair is very often connected with disease, and almost invariably so with loss of power.. The human being, however, is not, like these quadrupeds subject to an annual renewal of the covering of the skin; the hair once produced, continues to grow for many a year, perhaps for life, by prolongation from the root.

There is considerable difficulty respecting this change of external covering in the sheep. It has been commonly believed that there is a periodical moulting, or separation of the old fleece from that which is growing underneath; and there is no doubt, that the greater part or the whole of the fleece of the more neglected breeds begins, about the commencement of summer, to detach itself from the pelt; and much of it would be lost if its separation were not anticipated by the application of the shears. On the other hand, the wool of the lamb that was dropped in the winter or spring shows no disposition to separate, but continues to grow; and the observation of this has introduced a practice, the advantage of which will hereafter be considered, of leaving the hogget wool, for the first sixteen or eighteen months, to acquire additional length of staple. The Merino sheep affords a singular proof how easily the annual change of the fleece—if annual change there is—may be suspended in the domesticated state of that animal. Lord Western has retained the wool of the Merino, without the slightest disposition to separate, during three years. The experiment was also tried at Rambouillet, and the fleece remained on firm and healthy during five years. It had attained its utmost growth at the fourth year, when it was 13 inches long; but it had no disposition to separate from the skin, and probably it would not have fallen off during the life of the sheep*. There were not merely a few cases of this, but the experiment succeeded in every sheep on which it was tried.

How is this to be accounted for? Is it argued, that the sheep, from exposure to cold in the winter, throws out a diminished and tender fibre, and that, in the spring, the fleece becoming heavy, and getting entangled in the underwood, is easily torn off, the fibres giving way at the tender part or *joint?* This can scarcely be conceded; for whether the winter is mild or severe, the mountain-breeds, and the neglected breeds of sheep (and the short-woolled breeds, more than those who carry long wool, and on whom the fleece would hang heaviest) have, at the latter part of the spring of the year, a decided tendency to cast off their winter clothing. If other wool-bearing animals are examined, there is the same tendency to get rid of that which was given to them for a temporary purpose. The gnoo, the wapiti, the Barbary deer, in our menageries, are striking illustrations of this periodical decidence of the winter coat. The same is familiar to the keeper in every deer-park. The exuviæ—the cast-off covering—consists prin-

* Mr. Luccock very properly remarks that "the decidence of the fleece does not appear to be a characteristic feature of the tribe—an universal law to which all sheep are subject, because some individuals have been observed to retain their coat through two whole years, and a few have carried it even three whole summers. We are not aware that this faculty of retaining the fleece is confined to any particular breed of sheep, nor is it a quality common to every individual. The breeds producing a finer kind of wool often peel and lose a portion of their coat early in the spring, and before the summer had passed would probably part with the whole of it. The pile of the long-wooled sheep seems to be much more firmly attached to the pelt than that of the other breeds, for if the animal is kept in good condition and in good health throughout the whole period when the wool is growing, there is no symptom of a disposition to cast the fleece; while those sheep that have been kept upon commons all the winter, or even in enclosures upon hard fare, will part with it very easily when the food becomes more plentiful, and the condition of the animal is restored to its natural state."—P. 118.

cipally of the woolly portion of the coats, mixed with a variable quantity of hair entangled in it as it had slowly worked its way through the external covering.

This annual separation of a portion of the covering seems to be of almost universal occurrence. It is a consequence of the grand law of nature, that what the comfort and the thriving of the animal requires is, generally speaking, bestowed; but it begins to be removed as soon as it ceases to be needed.

It seems to be almost impossible to account for the universal adoption of the practice of shearing, and everywhere at nearly the same period of the year, except in order to anticipate this periodical separation and loss of the fleece.

The regular peregrinations of the early shepherds from the north to the south, as the summer waned, and from south to north, as the cold became less intense—this approach to equality of temperature all the year round—would, in proportion as the vicissitudes of the seasons were avoided, render an alteration in the fleece less necessary, and the tendency to this periodical decidence less strong. The disposition to part with the wool, which now varies in different breeds, might vary in the sheep of that day; if there were distinctions of breed (and certainly it would vary in different individuals) advantage would soon be taken of that fundamental principle of breeding which had been gradually lessening the quantity of hair and increasing that of wool; and those animals would be selected which not only carried the most wool, but which also evinced the strongest disposition to retain it. Thus, by degrees, a breed would be established, which, if well fed and kept in good condition, and somewhat defended from the inclemency of the winter's cold, would not only retain its wool until it suited the owner's convenience to remove it, but during an indefinite period of time. Still, as takes place in the occasional intermingling of the hair that once formed the outer coat—and the return, even at this distant period, of the primitive colour of the sheep—accident, neglect, cold, starvation, and carelessness as to selection, might, to a greater or less extent, call into action the principle by which the clothing of other wool-bearing animals is governed, and which cultivation and careful selection had suspended in the sheep.

When, before the invention of shearing, the value of the wool had been ascertained, and the occasional falling off of the fleece observed, a singular but inhuman method was resorted to in order to loosen the wool, so that it might be torn from the sheep nearly in one bulk. The poor creatures were confined for three or four days, until they were in a state of the utmost debility, and the fibres of the wool, sharing in the general weakness and derangement, might be without difficulty detached from the skin.

When the fleece of the sheep, either from periodical influence, or some accidental cause, is about to separate from the skin, it does so over the whole or a very considerable part of the body at once; the filaments seem to be simultaneously acted upon by the same power. While the new crop springs up, the old one falls off in large patches, or might be removed altogether: so that no sooner does the fleece cease to be of use to the animal than it is ready to be taken possession of by man, entire or nearly so, in which state alone it can be of any value to him, and converted to valuable purposes. It is true that the interlacing of the fibres of the wool will prevent them from falling so decidedly one by one as in the horse; yet a contemporaneous loosening, over large spaces, can alone account for the manner in which it sometimes appears to come away bodily from so great a part of the animal

### THE FORM OF THE FIBRE.

The fibre of the wool, having penetrated the skin and escaped from the yolk, is of a circular form, (varying in diameter in different breeds, and in different parts of the same fleece,) generally larger towards the extremity and also towards the root, and in some instances very considerably so.

The filaments of white wool, when cleaned from grease, are semi-transparent; their surface in some places is beautifully polished, in others curiously encrusted, and they reflect the rays of light in a very pleasing manner. When viewed by the aid of a powerful achromatic microscope, the central part of the fibre has a singularly glittering appearance. Very irregularly-placed minuter filaments are sometimes seen branching from the main trunk like boughs from the principal stem. This exterior polish varies much in different wools, and in wools from the same breed of sheep at different times. When the animal is in good condition and the fleece healthy, the appearance of the fibre is really brilliant; but when the sheep has been half-starved, the wool seems to have sympathized with the state of the constitution, and either a wan, pale light, or sometimes scarcely any, is reflected.

If any great and injudicious alteration has taken place in the management of the sheep during any period of the year, although the fibre may continue to preserve a portion of its brilliancy, a very considerable difference in its appearance will be immediately detected. Some have said (but our microscopical observations on wool will show that to be scarcely possible) that occasionally the change in the structure of the filament is so great that a certain length of hair is interposed between two portions of wool; often, however, close observation will discover a remarkable diminution of the bulk of the fibre, a withered and opaque surface, and a partial loss of the characteristic serrations and cones. These wools are much deteriorated in value; they will give way under the operation of the comb, and will injure or spoil the manufacture in which they are used. A microscope is not always needed in order to discover this change in the wool; but if such an instrument is at hand—and no wool-stapler or wool-grower should be without one—the semi-transparency of the wool, and the opacity of the hair,—and the roundness and fulness of the healthy fibre, and the withered appearance of the joint, or *breach*, as it is called, will form a singular contrast.

As a general rule, the filament is most transparent in the best and most useful wools, whether long or short. It increases with the improvement of the breed, and the fineness and healthiness of the fleece; yet it must be acknowledged that some wools have different degrees of transparency and opacity which do not appear to affect their utility or value. In the Vigonian wools the staple is nearly opaque, but the wool is remarkable for its smooth and silky texture. It is, however, the difference of transparence in the same fleece or in the same filament that is chiefly to be noticed as impairing the value of the wool.

Mr. Luccock speaks of some families of sheep in which the pile is flat and smooth like a small bar of finely-polished steel. A few filaments of wool of this kind the author has observed, but they have seldom been sufficiently numerous to be regarded as constituting the character of the fleece, and in the decided number of cases the appearance has been altogether deceptive. It has arisen from the direction in which the light has fallen on the object; and the lamp being raised, or lowered, or drawn on one side, the seemingly flattened bar assumed its circular but withered form. These sheep had been cruelly neglected, the secretion of the woolly

fibre had never been healthily discharged, and the whole fleece, or a great portion of it, might be said to have assumed a *breachy* character.

### THE PROPERTIES OF WOOL.

A consideration of the most important properties of wool, now taken in a very general way, and to be hereafter applied to the different breeds of sheep, cannot be better introduced than in the words of one to whom the agriculturist, whatever department of husbandry may chiefly occupy his attention, is much indebted. He is speaking of the size of the fibre, or the fineness or coarseness of wool. "Fine and coarse," says he, "are but vague and general descriptions of wool; all fine fleeces have some coarse wool, and all coarse fleeces some fine. I shall endeavour, for the information of my readers, to distinguish the various qualities of wool in the order in which they are esteemed and preferred by the manufacturer. First, fineness with close ground, that is, thick-matted ground. Second, pureness. Third, straight-haired when broken by drawing. Fourth, elasticity, rising after compression in the hand. Fifth, staple not too long. Sixth, colour. Seventh, what coarse is in it to be very coarse. Eighth, tenacity. Ninth, not much pitch-mark: but this is no other disadvantage than the loss of weight in scouring.

"The bad or disagreeable properties are—thin, grounded, toppy, curly-haired, and, if in a sorted state, little in it that is very fine; a tender staple, no elasticity, many dead white hairs, very yolky. Those who buy wool for combing and other light goods that do not want milling, wish to find length of staple, fineness of hair, whiteness, tenacity, pureness, elasticity, and not too many pitch-marks*." These supposed good and bad qualities will not be taken in the order here enumerated, for the propriety of some of them may admit of doubt; few, however, will be entirely omitted.

### FINENESS.

That property which first attracts attention, and which is of greater importance than any other, is the fineness of the pile—the quantity of fine wool which a fleece yields, and the degree of that fineness. Of the absolute fineness little can be said. It varies to a very considerable degree in different parts of the same fleece, and the diameter of the same fibre is often exceedingly different at the extremity and the centre. The micrometer has sometimes indicated that the diameter of the former is five times as much as that of the latter; and consequently, that a given length of pile taken from the extremity would weigh twenty-five times as much as the same length taken from the centre and cleansed from all yolk and grease †.

That fibre may be considered as coarse whose diameter is more than the five-hundredth part of an inch; in some of the most valuable samples of Saxony wool it has not exceeded the nine-hundredth part of an inch; yet in some animals, but whose wool has not yet been used for manufacturing purposes, it is less than one-twelve-hundredth part of an inch.

The fineness of the wool differs greatly on the different parts of the sheep. That running down the side of the neck and covering the shoulders, the ribs, and the back, is the finest; the next covers the superior part of the legs and the thighs, and extends up to nearly the haunch and the tail; and a still inferior portion runs along the upper part of the neck, the throat, the breast, the belly, and the lower part of the legs. There is considerable variation in this respect in different breeds, and in individuals of the same

* Young's Annals of Agriculture, vol. xviii., p. 329.
† Luccock, p. 178.

breed; and, although a fleece, taken generally, may be said to be adapted to a particular use, yet a portion of it may be employed in the manufacture of a much more valuable article; and at the same time a greater quantity will be thrown aside as not sufficiently fine for the originally intended purpose.

### THE WOOLSTAPLER.

This is the business of the woolstapler,—the middleman between the breeder and the manufacturer. He purchases the fleece, and occasionally sells it in the same state, but oftener *assorts* it; dividing it into different parcels, according to their degree of fineness principally, or the possession of some property which fits it for a certain manufacture. The sorter, who ought to have a delicate sense of touch and a quick eye, has several baskets around him, distinguished, at least in his mind's eye, by a certain number according to the fineness of the staple, and into which, with a rapidity that would surprise the inexperienced observer, and with an accuracy that can seldom be disputed, he divides the wool. There are seldom fewer than six divisions, and sometimes more than double that number, according to the quality of the fleece, or the expected demand for wools of a certain kind. The manufacturer, who knows precisely what wool will suit his purpose, and to whom the remainder would be useless, is thus enabled to obtain from the stapler, without trouble or risk, the quantity and the sort that he requires *.

The short wool fleeces are usually distributed into ten parcels. *The picklock*—as its name, the picked locks, would imply—is the very best and choicest wool of the kind, and many fleeces of inferior wool are sometimes assorted before any great quantity is thrown into this basket. *The prime*, an excellent wool, and but in a slight degree inferior to the first. The two next divisions, *the choice* and *the super*, are good wools, but the fineness or the trueness of the staple gradually decreasing. The greater part of a good *Down* fleece would, on assortment, be chiefly thrown into one or the other of these compartments, but some proportion even of the best would find its way into the baskets yet to be mentioned. *The head*, this title either indicates the part of the sheep whence the wool is usually procured, or that it is at the head of the inferior sorts. The sixth division is—*the downrights*, an honest, sound wool; but that is all that can be said about it. Next comes *the seconds*—the best of the wool from the throat or breast. The eighth is—*the abb*, a disputed and unintelligible term, meaning a still inferior wool. *The livery*—principally the skirtings and edgings, and *the short coarse* or *breech wool*, that which comes from the breech of the animal.

### THE INFLUENCE OF TEMPERATURE.

Various causes affect the fineness of the pile; and temperature, if not the most powerful of them, deserves more attention than has been paid to it. It has already been observed, and it is a matter of common remark, that the extremities of the wool, and, frequently, those portions which are near to the root, are larger than the intermediate parts. The extremity of the fibre has generally the greatest bulk of all. It is the product of summer,

* —— Nimbly, with habitual speed,
They sever lock from lock, and long and short,
And soft, and rigid, pile in several heaps.
This the dark hatter asks; another shines
Tempting the clothier; that the hosier seeks;
The long bright lock is apt for airy stuffs.

DYER'S *Fleece*, b. ii.

soon after the shearing time; when the secretion of the matter of wool is increased, and when the pores of the skin are relaxed and open, and permit a larger fibre to protrude. The portion near the root is the growth of the spring, when the weather is getting warm; and the intermediate part is the offspring of winter, when, under the influence of the cold, the pores of the skin contract, and permit only a finer hair to escape; while, probably, some of the cutaneous glands concerned in the growth of the fibre cease to act*.

If, however, the animal is well fed, the diminution of the bulk of the fibre will not be followed by weakness or decay, but in proportion as the pile becomes fine, the value of the fleece will be increased; but if cold and starvation should go hand in hand, the woolly fibre will not only diminish in bulk, but in health and strength and worth.

The variations in the diameter of the wool in different parts of the fibre will also curiously correspond with the degree of heat at the time the respective portions were produced. The fibre of the wool, and the record of the meteorologist will singularly agree, if the variations in temperature are sufficiently distant from each other for any appreciable part of the fibre to grow †.

* The wool of the lamb—whether shorn in the first summer, or remaining until the second under the denomination of hogget wool—is an exception to this: the extremity of the fibre is *pointed*. It is easy to suppose that this would be the natural form of the fibre when it first pierces the summit of the bulb; but at a very short distance from the extremity it begins to obey the same law which governs the other wool, and varies in diameter, according to the temperature of the season.

Some of the French philosophers account for the pointed extremity of the wool in the lamb, and its increase of bulk in older sheep in a very curious way. "The fibre of wool continues to derive nourishment from the fluid contained in the bulb whence it sprang; some part of this fluid it assimilates for its own growth, and the superabundant part it excretes or throws off. In the first wool of the lamb, the extremity of which has not been cut, this excretion can only take place by means of the pores in the tissue of the hair; but when, in the shearing, the canal of the tube is opened, an easier and more abundant secretion will be established, and the fluid will take the habit of flowing towards the newly-effected aperture. It may also be added, that the porous tissue of the wool possessing the property of absorption, that function will be exerted more efficaciously towards the exterior extremity of the fibre, which lies on the surface of the fleece, than on the part near the root which is closely covered, and thus the fibre increases in bulk towards its exterior extremity."—*Nouveau Traité sur la Loine par* Le Vicomte Perrault de Jotemps *et* MM. Fabry (fils) *et* F. Girod de L'Ain.

† Dr. Anderson was the first who noticed this self-registering animal thermometer, and his account of it ought to be recorded. "This phenomenon appeared to tally so exactly with the idea I had preconceived, as to make me afraid lest I might become the dupe of my own prejudices, which might make me imagine that I actually perceived things that only existed in my own imagination.

"To satisfy myself, however, experimentally, as to the difference in these respects between the wool of this and the former year (1773 and 1774-5), I was at pains to procure some wool of the last year's growth.

"1. The difference between the point and the root of the filament of wool of crop 1773-4 was much greater than between the two ends of the filament that grew in the year 1774-5; and

"2. The difference between the root end and the smaller part of the filament was much greater in the wool or crop 1774-5 than in that of the former season. This was perceived and acknowledged by others besides myself, as before, to prevent my being deceived.

"These phenomena were the natural consequences of the two different seasons in which the separate filaments were produced; for the summer of 1773 was very warm and comfortable, and the winter of the same year uncommonly mild; the spring of the year 1774 having been the coldest and most uncomfortable that was almost ever known.

"Hence the points of the wool were coarse and the roots fine to as great a degree as may ever be expected to happen in this climate; and as there was little variation between the temperature of the winter 1773-4, and the spring 1774, there was likewise little variation between the roots and the finest parts of the filament.

"But

It will follow from this, that the natural tendency to produce wool of a certain fibre being the same, sheep in a hot climate will yield a comparatively coarse wool, and those in a cold climate will carry a finer, but at the same time a closer and a warmer fleece. In proportion to the coarseness of the fleece will generally be its openness, and its inability to resist either cold or wet; while the coat of softer, smaller, more pliable wool will admit of no interstices between its fibres, and will bid defiance to frost and storms.

The natural instinct of the sheep would seem to teach the wool-grower the advantage of attending to the influence of temperature on him. He is evidently impatient of heat. In the open districts and where no shelter is near, he climbs to the highest parts of his walk, that if the rays of the sun must still fall on him he may nevertheless be cooled by the breeze; but if shelter is near, of whatever kind, every shaded spot is crowded with sheep.

Lord Somerville says, "The wool of our Merino sheep after shear-time is hard and coarse to such a degree as to render it almost impossible to suppose that the same animal could bear wool so opposite in quality, compared to that which had been clipped from it in the course of the same season. As the cold weather advances, the fleeces recover their soft quality*." Enough will be said in the course of the work respecting the duty and the propriety of giving these useful animals, when placed in exposed situations, some shelter from the driving storms of winter; and the alteration in the fibre of the wool shows that it would also be advisable to provide the flock with a shade and defence against the fervid rays of a meridian sun in the summer-months.

A writer of high authority thus expresses himself: "Sheep carried from a cold to a warmer climate soon undergo a remarkable change in the appearance of their fleece. From being very fine and thick, it becomes thin and coarse; until at length it degenerates into hair. Even if this change should not take place to its full extent in the individual, it will infallibly do so in the course of one or two generations. The sheep that we see covered with hair are not therefore in reality a different species from those that are woolly, nor is wool in its nature specifically different from hair—it is only a softer and finer kind of hair. The effect of heat is nearly the same on the hairs of other animals. The same species that in Russia, Siberia, and North America, produce the most beautiful and valuable furs, have nothing in the warmer climates, but a coarse and thin covering of hair†."

It will be evident from what has been already said of the gradual change from hair to wool, that this account must be received with very great limitation. Temperature and pasture have influence on the fineness of the fibre, and one which the farmer should never disregard; but he may, in a great measure, counteract this influence by careful management, and selection in breeding. The original tendency to the production of a fleece of mixed materials existing, and the longer coarse hair covering and defending the shorter and softer wool, nature may be gradually adapting the animal to his new locality; the hair may increase and the wool may diminish, if man is idle all the while; but a little attention to breeding and management will limit the extent of the evil, or prevent it altogether. A better

"But as the heat of the spring 1775 was greater than we almost ever experienced, the roots of the wool of that year's growth were uncommonly coarse, so as to differ much more than usually happens from the small parts of the filament produced in winter, which was probably the cause of my remarking it so readily that year although it had escaped me before."—Anderson on Wool, p. 124-127.

* See his note on the effect of temperature. Bakewell, p. 26. Ibid. p. 154.

† Account of Pegu, by Mr. Hunter. 1785.

illustration of this cannot be found, than in the fact that the Merino has been transplanted to every latitude on the temperate zone and to some beyond it—to Sweden in the north, and Australia in the south, and has retained its tendency to produce wool exclusively, and wool of nearly equal fineness and value.

Mr. Luccock's summary of the effect of temperature on wool is so much to the purpose in the present state of knowledge, or rather comparative ignorance, of this subject, that it is quoted here. "If the manner in which wool is produced were more accurately noticed—if the effects of changing seasons were more diligently noted—if care were taken to preserve the fleeces which an individual had afforded in different situations and under varied treatment, so that they might be compared with each other—and if the staple were either measured or marked at regular intervals of time, we should ascertain a number of facts respecting the production of wool, which we are at present ignorant of; and perhaps might be able to procure it in a much more perfect state. Until our knowledge becomes more perfect, we must consider the influence of temperature as reduced to one point, which requires only that the shepherd do not unnecessarily expose his flocks to the extremes of heat or of cold, nor to any capricious changes." This last sentence cannot be fully assented to, but the former remarks are invaluable.

### PASTURE.

Pasture has a far greater influence on the fineness of the fleece. The staple of the wool, like every other part of the sheep, must increase in length or in bulk when the animal has a superabundance of nutriment; and, on the other hand, the secretion which forms the wool must decrease like every other, when sufficient nourishment is not afforded.

When little cold has been experienced in the winter, and vegetation has been scarcely checked, the sheep yields an abundant crop of wool, but the fleece is perceptibly coarser as well as heavier. When the frost has been severe and the ground long covered with snow—if the flock has been fairly supplied with nutriment, although the fleece may have lost a little in weight, it will have acquired a superior degree of fineness, and a proportional increase of value. Should, however, the sheep have been neglected and starved during this prolongation of cold weather, the fleece as well as the carcase is thinner, and although it may have preserved its smallness of filament, it has lost in weight, and strength, and usefulness. These are self-evident facts, and need not to be enforced by any laboured argument; and therefore it is that since the sheep-breeder, living in a populous country, has begun, and judiciously so, to look more to the profit to be derived from the carcase—since the system of artificial feeding has been brought to so great perfection—and a larger and better animal has been earlier sent to market, and a far greater number of sheep can now be fed and perfected on the same number of acres, the wool also has been somewhat altered in character — it has grown in length, and it has increased in bulk of fibre. *It has not deteriorated, but it has changed.* If no longer fit for the purposes to which it was once devoted, it has become suited to others. If it no longer brings the extravagant price it once did, it meets with a readier sale. The increase of the number of fleeces, and the increase of weight in each fleece, go far to compensate for the diminution of price, while the improvement of the carcase more than supplies the deficiency, if in truth there were any: so that, considering the badness of the times, and the state of agriculture generally, the sheep is comparatively more valuable to the breeder than he was

before. This will be touched on at greater length when the various breeds of British sheep pass in review, and their present state and produce is compared with what they were half a century ago.

Wool is now the subject of consideration, and there can be no doubt that in Great Britain it has materially changed its character since the introduction of artificial food, and the adoption of the forcing system. Mr. Nottage states, of the Western Down sheep, that he used to get one-eighth part of the finest English wool from each fleece; but that now the quantity is so small that he does not throw it out: he does not set a basket for it at all. Mr. Sutcliffe says, that "Thirty years ago there was, in some South Down flocks, nearly as good wool grown, as the fine German that now comes into our country." Mr. Varley adds, that "he used to throw his wool extremely high to the sort—very good to the sort—but he found that the qualities generally were getting so low, that if he continued that sort of practice, he should have been looking into two of his best bins without finding a bit of wool in them." Mr. Fison states of the Norfolks, that "in 1780, 420lbs. of clothing wool grown in Norfolk would produce 200lbs. prime—in 1828, it would produce only 14lbs*."

These are convincing proofs of the effect on the fleece of high keep, and the breeding for larger sheep.

In the early establishment of the improved Leicesters, it was an accusation, which their most zealous supporters did not attempt to deny, that the wool was sacrificed to the carcase; nay, the very founder of that breed of sheep stated to his namesake of Wakefield that "he had no doubt that fine wools might be grown on rich pasture lands by overstocking them, and preventing sheep from obtaining more nourishment than they had been accustomed to†."

Dr. Parry, whose observations on sheep-husbandry always deserve attention, and whose opinions, except when he was deluded by his fondness for the Merinos, are very correct, says that sheep-breeders "had observed a sort of gross connexion between the food and the quality of the fleece. On the one hand, the staple of a sheep that was starved was weak, and the wool dry and unprofitable in the manufacture. On the other hand, the wool of sheep on deep inclosed pasture, or on artificial food, was found to be coarser and more intractable than that from the downs. On these two simple facts they thought themselves qualified to reason, and, as is unavoidable from insufficient premises, they reasoned falsely. They concluded that the fine herbage of the downs necessarily produced fine wool; and that none but coarse wool could spring from gross luxuriant food. Neither of these conclusions is precisely true. The fineness of a sheep's fleece of a given breed is, within certain limits, inversely as its fatness, and perhaps also (although I am not certain of this point) as the quickness with which it grows fat. A sheep which is fat has usually comparatively coarse wool, and one which is lean, either from want of food or disease, has the finest wool; and the very same sheep may at different times, according to these circumstances, have fleeces of all the intermediate qualities from extreme fineness to comparative coarseness‡."

All this is very true and very important; except that opinion, of the truth of which Dr. Parry confesses that he is not certain, "that coarseness

* Examinations before the House of Lords in 1828. † Bakewell on Sheep, p. 84.

‡ Columella, whose sheep were cultivated principally for their fleece, mentions the hungry lands about Parma and Modena, as feeding the most valuable sheep; and Virgil was perfectly aware of the influence of luxuriant pasture in giving coarseness to the fleece when he warns against the "*pabula læta*,"—

Nor in too rank a pasture let them live.

of wool and disposition to grow fat are connected. The experience of the British sheep-master would prove that the finest woolled sheep will maintain themselves in tolerable condition where coarser ones will starve; and that when both are placed in a situation to exhibit their tendency to fatten quickly, and to a great extent, the fine woolled sheep will beat his rival out of the field.

"There used to be great controversy with regard to the influence of particular kinds of food on the wool. There are no decisive proofs as to this. Between diversities of food wholesome and nutritious, there will be little to choose; or rather experience will prove that an occasional change of food is not only grateful but advantageous to the sheep*."

### TRUENESS.

Connected with fineness is trueness of staple—as equal a growth as possible over the animal—a freedom from the shaggy portions, here and there, which are occasionally observed on poor and neglected sheep. These portions are always coarse and comparatively worthless, and they indicate an irregular and unhealthy action of the secretion of wool, and which will probably weaken or render the fibre diseased in other parts.

Comprised in trueness of fibre is another circumstance that has been already alluded to—a freedom from coarse hairs which project above the general level of the wool in various parts, or, if they are not externally seen, mingle with the wool and debase its character.

In the same term, and most important of all, is a freedom from those irregularities in the bulk of the fibres of the wool, which render it difficult at times to give it a definite name and character, and which must materially interfere with its usefulness; and also those *breaches* in the wool so singular in their appearance, which have been already described, and the distance of which from the extremity or the root will enable the observer, as has been already stated, to calculate the time when the imperfection occurred, and which may generally be traced to cold or starvation, or to some malady of the skin itself†."

### SOUNDNESS.

Soundness is intimately connected with "trueness;" it means strength of the fibre generally, and also a freedom from those breaches or withered portions to which allusion has been made. The unassisted eye, or at least the eye of the wool-stapler or sorter, will readily detect the breaches; but the hair generally may not possess a degree of strength proportionate to its bulk. This is ascertained by drawing a few hairs out of the staple, and grasping each of them singly by both ends, and pulling them until they break.

Soundness is a very important property in wool, and was absolutely indispensable in long wool when that alone was subjected to the operation of the comb. If it broke in pieces in the act of combing, the shreds (termed

* Bath Society Papers, vol. xi. p 211.

† ——— It oft deceives the artist's care,
Breaking unuseful in the steely comb:
For this long spongy wool no more increase
Receives, while winter petrifies the fields.
The growth of autumn stops; and what though spring
Succeeds with rosy finger and spins on
The texture; yet in vain she strives to link
The silver twine to that of autumn's hand.
Be then the swain advised to shield his flocks
From winter's deadening frosts and whelming snows.

DYER'S *Fleece*, b. ii.

noils) were useless in the worsted manufactory, and, indeed, were regarded as little better than refuse: when it is recollected that the clothing-wools are not required to possess so great a degree of strength as the old combing ones, but, on the contrary, would be less useful if they had this strength; and that now, many short wools being made to undergo the process of combing,—the sound portion of one part of the staple may be mixed with the tenderer fibre from another part or another fleece, and, possibly, even a denser pile may be raised on the surface of the cloth. There is, however, a limit to the tenderness of that clothing-wool, which may pass muster with the manufacturer. Not only the pile may be properly broken under the operation of the card, but it may become so comminuted that it will either be driven away, dissipated by the action of the cylinders, or it may afterwards break, and the fabric of the cloth be destroyed under the beating of the fulling-mill.

The wool of sickly or murrain sheep is generally not only finer than in a healthy sheep of the same breed, but it possesses this tender quality, not to be detected by the eye, nor even by the microscope; unless that it may be suspected by a slighter degree of polish, and not having so full and round an appearance.

Age has often much effect in deteriorating the fleece. The yolk lessens in quantity after the sheep, and especially the ewe, is six years old; and, to the decrease of the yolk, there soon follows a hard, inelastic, unyielding character of the wool, that renders it useless for several purposes for which the younger, and especially the wether-wool, is sought. Mr. Luccock applies a very singular, but appropriate word, to this old ewe-wool—"it dies in the bowl*"—it sinks in the water in which it is washed—and acquires there a shrivelled and dead-like appearance. It is difficult to spin, and it materially injures the manufacture in which it is employed.

The wool often becomes considerably injured by felting while it is on the sheep's back. This is principally seen in the heavy breeds, especially those that are neglected and half-starved. It generally begins in the winter season, when the coat has been completely saturated with wet; and it increases until shearing time, unless the cot separates from the wool beneath and drops off. The *cotting* of wool is only an injurious extension of the process of felting—the wool forms into a hard thick knot that can scarcely ever be unravelled.

Some breeds are more subject than others to this defect: the Morfe sheep and the Cheviots have been especially accused of possessing this harling property in the wool. It occurs before the wool has begun to separate from the skin; but then by its weight, and the manner in which it acts on the portion below, the wool begins to be gradually detached from the back and connected only by a few scattered hairs, while a new crop grows underneath.

Collections of a similar kind are frequently seen under the ears of long and fine-haired spaniels.

Mr. Parkinson speaks of two diseases, or rather defects of wool †. The first he calls a *feathery* wool, set very thinly upon the pelt, and falling very closely together. "When shorn it laps up in very small bundles, and weighs heavy, according to its substance, but the whole fleeces are of light weight; it also is weak and curled, and breaks much in combing." This, with his wonted prejudice against the improved Leicesters, he affirms to be the usual character of their wool.

The other defect he calls *watery* wool,—"it is so full of grease that it looks damp; and a stranger to this kind of wool would be assured that it

* Luccock, p. 134. † Parkinson on Live Stock, vol. i. p. 261.

had been wetted, and the proper smell of the wool will alone undeceive him." This wool, according to him, is frequently seen on the coarse Lincolns. He says that this *watery* wool is a very bad sort, and on poor sheep is frequently cotted, and at all times is of an objectionable quality for the manufacturer.

Wool is generally injured by keeping. It will probably increase a little in weight for a few months, especially if kept in a damp place; but after that it will somewhat rapidly become lighter, until a very considerable loss will often be sustained. This, however, is not the worst of the case; for, except very great care is taken, the moth will get into the bundles and injure and destroy the staple; and that which remains untouched by them will become considerably harsher and less pliable. If to this the loss of the interest of money is added, it will be seen that he seldom acts wisely who long hoards his wool, when he can obtain what approaches to a fair remunerating price for it.

### SOFTNESS.

If the pile is sound, there are few qualities in wool of so much consequence as softness. Fashion has done much in effecting this. Since the importation of the soft wools of Spain and Saxony, even the farmer himself will no longer wear the good, but somewhat harsh clothing with which he used to be content. He does not examine, and the manufacturer is not anxious to exhibit, the fineness or the trueness of the threads of the cloth; but his judgment is guided by the softness, and at the same time the substance of the material, and he is perfectly right: for no clothing is so comfortable or so durable as that which the increased pliability and softness of the woolly fibre, and the application of the fulling-machine, and the improvement of machinery generally, have produced.

The old manufacture of cloth could not be carried on to any degree of perfection, except the material on which the workman operated was soft and pliable. A stubborn and a brittle substance would perish under the manipulations to which it was necessarily subjected; or, after the exertion of his greatest skill, the fabric would do the workman little credit: for the thread would not be firm, nor would the surface of the cloth be pleasing to the feeling. It is now admitted that the pile can scarcely be too soft and silky, if the strength is not impaired *; and it has been affirmed, that two packs of sorted wool being taken, possessing the same degree of fineness, but the one having the soft quality in an eminent degree, and the other being harsh, the cloth prepared from the first, at the same expense, will be worth more to the manufacturer than the other by full 25 per cent.

The cause of this softness of pile, or the means by which it may be induced or increased, are not yet sufficiently known. It may hereafter appear that the mechanical structure of the wool,—those irregularities of surface,—those joints possibly—of which we shall presently catch a glimpse—have much to do with it; and their number, or their action, although depending mostly on the breed, may yet be influenced by circum-

* The opinion that softness was essential to the woolly fibre is of no recent date. Varro speaks of the wool,—"Quæ multa sit et mollis, villis altis, et densis toto corpore," —wool, great in quality, and soft, long in the fibre, and equally diffused over the whole of the body. It must not, however, be hastily concluded that they were long-woolled sheep that were then mostly prized; but that comparative length, as well as softness of fibre, were essential qualities.

Palladius, another valuable writer on ancient husbandry, recommends the sheep,—"Vasti corporis, et prolixi velleris, ac mollissimi,"—of large size, with long wool, and that of the softest character.

stances over which the sheep-master has considerable control. There can be no doubt that this quality is mainly dependent on the fineness of the fibre. A thread must be more flexible than a cord. It is also evidently connected with the breed: there are some sheep to whose fleece no degree of neglect can communicate a decidedly harsh character, while the wool of others has many valuable properties, but there is a stubbornness about it which the sheep-farmer has tried in vain to eradicate.

Softness of the pile is evidently connected with the presence and quantity of yolk. There is no doubt that this substance is designed, not only to nourish the hair, but to give it richness and pliability. In what way is the growth of the yolk to be promoted? By paying more attention than our agriculturists are accustomed to give to the quantity and the quality of this substance possessed by the animals which they select for the purpose of breeding. The quantity and the quality of the yolk, on which many farmers now scarcely bestow a thought, and the nature of which they neither understand nor care about, will, at some future time, be regarded as the very essential and cardinal points of the sheep.

Bad management, neglect, exposure, starvation, impair the pliability of the woolly fibre, but chiefly so because they arrest the secretion of the yolk, or change its properties. It is because the salving of the sheep either increases the production of the yolk, where it was comparatively deficient, or acts as a substitute for it, and that of no mean power, that the northern breeders so universally have recourse to it. Mr. Bakewell's testimony deserves recording here. "I was led to the application of it," says he, "by observing the well-known effect produced on human hair when daily washed with soap and water, and comparing it with the same hair less frequently washed, and sometimes rubbed with an ointment; by the former practice it became hard and bristly, by the latter it was rendered soft and pliable. A little time after, an intelligent clothier in my neighbourhood who kept a small flock of fine-woolled sheep, informed me he had adopted the practice of rubbing the sheep with a mixture of butter and tar. He could speak decidedly to the improvement the wool had received by it, having superintended the whole process of the manufacture. The cloth produced was superior to what ungreased wool could have made, if equally fine; it was remarkably soft to the touch, and had what he called 'a good bottom, a good top, and a good hand and feel'—*i. e.*, the appearance of the threads was nearly lost in a firm even texture, covered with a soft full pile." Mr. Bakewell, adds, "a further investigation has given me the most ample and satisfactory proofs, that by the application of a well-chosen unguent, wool may be defended from the action of the soil and elements, and improved more than can be effected by any other means, except an entire change of breed." These are strong assertions, but no less strong than true, with regard to those breeds, and situations where salving is indicated.

On the effect of *clothing*, the evidence is strangely contradictory: this, however, is not the place to enter fully into the consideration of it. There can be no doubt that it is indispensable with regard to the choice specimens of the New Leicester breeding rams. On account of their fatness it is often necessary to shear them early in the season; and, in order that the supposed beauty of their form may be more perfectly displayed, it is usual to shear them exceeding closely; there would, consequently, be danger of catarrh, or many sad chest affections, if they were at once exposed to the frequently piercing cold of a spring night. This artificial covering is, however, in the majority of cases, left off as soon as the wool is a little grown. The expense of clothing, supposing, which is doubtful, that its

influence on the fineness and softness of the wool were established, would be an insuperable objection to its general use*.

There is no doubt that soil has much influence in producing harshness of the pile. A chalky soil notoriously deteriorates the softness of the wool on the sheep that graze there. Minute particles of the chalk being necessarily brought into contact with the fleece, and mixing with it, have a corrosive effect on the fibre, and harden it and render it less pliable. Many well-known facts render this highly probable. The business of the fellmonger furnishes a striking elucidation of this: his first proceeding is to separate the wool from the pelt; and in order to effect this he exposes it to the action of lime-water, and in a very short space of time the hair is shrivelled, killed, and easily scraped away.

In the living animal a process of the same kind may be more gradually going forward, aided also by another, little suspected, yet highly injurious. The particles of chalk come in contact with the yolk—there is a chemical affinity between the alkali and the oily matter of the yolk—they immediately unite, and a true soap is formed. The first storm washes away a portion of it, and the wool, deprived of its natural pabulum and unguent, loses some of its vital properties, and its pliability among the rest. The slight degree of harshness which has been supposed to belong to the South Down wools may be accounted for in this way.

Mr. Bakewell, to whose work, full of useful information, the author is proud to acknowledge himself frequently and deeply indebted, gives an illustration of this which will put an end to all doubt that could possibly remain about it. In the northern parts of Derbyshire the mineral strata are so abruptly broken, that two adjoining farms, separated by a small brook, would not unfrequently be found, the one on limestone, and the other on a siliceous grit or sandstone. The difference of the wool on those two farms, and from the same breed of sheep, and particularly with regard to its harshness or softness, is so distinctly marked, and was, even twenty years since, so well known, that the farmer would demand and obtain 1*s.* or 1*s.* 6*d.* per tod more for his wool when grown upon the latter soil.

### ELASTICITY.

There are two antagonist principles continually at work in every part of the frame of every animal; and it is on the delicate adjustment and balance

* The reader is presented with a strange and almost ludicrous contrariety of opinion on this point, expressed in different volumes of the same work, now out of date, but valuable in its time.

"The other experiment, that of clothing sheep, was tried on a small scale by Mr. Brodie at Upper Keith, near Edinburgh. The improvement in regard to the quality of the wool was very great, and fully justifies the accounts handed down to us by ancient writers respecting the advantages of that practice. It is believed that clothing the long-woolled sheep, and clipping them thrice a year, is the greatest improvement practicable with regard to that breed. It converts combing into clothing wool, and while it increases the quantity and improves the quality of the fleece, it is of essential service to the carcass. Common unbleached or green linen done over with Lord Dundonald's tar, by which the bad effects of wet, more prejudicial to the sheep than cold, are prevented, is the best covering. The expense is trifling, not exceeding 7*d.* each, and the covering will probably last, with common attention, two or three years."—Young's Annals of Agriculture, vol. xv. p. 436.

Now 'audi alteram partem:' "Clothing the sheep must, I imagine, be prejudicial both to the sheep and the wool. Without sun, air, or dews, the wool would not grow to more than two-thirds of its usual length, if so much, and the hair would be weak and rotten, and not possess sufficient strength to undergo the different operations of carding, skinning, &c. As to the sheep itself, it is more than probable that its constitution would be much weakened by having the external air kept from its body, and that the flesh would acquire a rancid, unpleasant flavour; as we find that a small degree of heat before a sheep is shorn has a surprising effect on the taste of the flesh, and that it does not acquire its usual flavour in less than three weeks or a month after the fleece is taken off."—Young's Annals of Agriculture, vol. xli. p. 515.

of power between them, that all healthy and useful action depends—the disposition to give way, or to submit to some alteration of form when pressed upon, and an energy, by means of which the original form is resumed, as soon as the external force is removed. It has been observed that a fibre of wool closely examined presents a succession of minute spiral curves. It may be extended between the fingers, but, as soon as one end is free, the hair resumes the corkscrew-form which it had before. Until some of its properties are impaired by art, it will pertinaciously resume its curved appearance whenever it has liberty so to do. It is the union of its pliability with this principle of elasticity—the facility of extension and the tendency to take on again its crumpled form, and each of them modified by various circumstances, that constitutes the usefulness, and, consequently, the value of wool.

The play of these powers is differently adjusted in different wools. In the finer sorts, and that were destined to form the thinner and more delicate fabrics, the balance between the yielding and elastic power is curiously and beautifully adjusted: hence, the softness and the fineness of the thread, and of the cloth—the facility with which it is shorn—the ease with which it yields to pressure, and yet the tendency to assume its natural form, and to cover the surface of the cloth with a dense nap, or innumerable minute curves. It is true that many of these are formed, or their formation is aided, by art—the scissors may cut away superfluous spirals —the heated plate may repress more of them; but to this modification of the principle of elasticity, this mysterious disposition to return to or resume the natural curve, the beauty and the value of the modern cloth is principally owing.

In coarser kinds of goods the elasticity of the fibre is more required, and it seems to have its full play. Without it, how would the manufacturer obtain the long and luxuriant nap with which the blanket is covered, or which are found on the thicker coatings that are made to brave the inclemency of the weather? If the natural direction and curve of the wool is changed, and kept so for a considerable time, the fibre seems to adopt the figure which is forced upon it, and the principle of elasticity is called into exercise to maintain the artificial curve. This is particularly the case if heat has been applied to produce the new direction in the hair. In this way the fanciful naps in various cloths are raised, some of which will maintain the form that has been forced upon them with all the pertinacity with which the fibres previously returned to their native drooping ringlet-like construction. The principle of elasticity is one of very great moment: there are many pleasing illustrations of its singular and beautiful modification, but there is much obscurity connected with its manner of acting, and it has not received the attention which it merits.

## COLOUR.

This is of minor, and yet of no trifling importance. The alteration of the colour was the first recorded improvement of the sheep—and its purity—its perfect whiteness—should never be lost sight of by the sheep-master of the present day. Very commendable attention has been paid to this. The South Down sheep has driven from his fleece the grey hue which his face and legs continue to wear; the Norfolk no longer retains on his back the negro-stain which he carries on his front; and although the colour of these breeds cannot quite compete with the pure white of some of the long-woolled sheep, there is little now to complain of so far as every useful purpose is concerned. It must, however, be confessed that the breeder is not, in every respect, so careful as he ought to be.

To a certain extent the fleece is frequently stained with the colour of the soil on which the animal grows. In some parts of Gloucestershire the wool acquires an orange colour; in Hertfordshire and Warwickshire it is of a brownish red, and in the fens of Lincoln and Cambridge it has a dark blue tint *.

The particles of the soil mixing with the fleece gradually stain it of their own colour. In some cases the acquired dingy or other hue may be removed by careful scouring; but this entails additional trouble and expense: in other instances the tint is permanent. It does not seriously interfere with the process of dyeing, except in a few cases of rare occurrence; but the wool is injured for other purposes where whiteness is required.

In some districts, and particularly in the west of England, the farmer needlessly uses a considerable quantity of ochre or ruddle, either in the composition of his salving mixture, or to gratify a foolish fancy. In either case he applies that which cannot produce any good effect, and which occasionally leaves a tint on the wool that the most careful scouring will not efface. The tar gives consistence to the oil or butter, and although it is often with considerable difficulty washed away, yet while it remains on the fleece it gives a permanency to the smearing process; not one plea, however, can be offered in favour of the ruddle.

The yolk sometimes leaves a permanent stain on the fleece. It rarely does so when this secretion has been plentiful and healthy: the stain is usually left when the yolk has been deficient in quantity, or altered in quality, or when the weather has been sultry, and too long time has been suffered to elapse between the washing and the shearing.

### FELTING.

It has been stated, when describing the patriarchal sheep, that although the clothing of the primitive family consisted of the skins of animals, and probably of the sheep, no very lengthened period would elapse before the circumstance of the felting or the matting of the wool on the back of the sheep would attract attention. When these matted portions were separated from the fleece, experiment—rude enough perhaps, or accident—would discover that these matted portions or others that were not previously harled, might, by moisture and pressure, or beating, be worked into a soft and pliable substance of almost any size or form, and from which a covering far more comfortable than any skin might be contrived. This has been the progress of improvement in dress, and in the manufacture of wool in every country, and almost every age. The wandering shepherds, who at the present day traverse regions similar to those in which the Patriarchs sojourned, thus manufacture the carpets that defend them from the cold and dampness of the ground. The Tartars spread two or three layers of wool moistened, and tread it under foot for a few hours, and form their carpets without the aid of the loom or the modern invention of cylinders †. "This latent property of felting," says Mr. Luccock, "seems to have been first excited by the pressure obtained by the weight of the human body. The cloth in its rough state being placed beneath the feet of the workmen, they continued to trample upon it until sufficiently thickened; hence, the person engaged in this employment was called a walker or welter of cloth, and the machine afterwards introduced to answer the same purpose was denominated a walking-mill ‡."

* Bakewell on Sheep, p. 31. † Ibid., p. 16.
‡ Luccock on Wool, p. 165, quoting from Mrs. Guthrie's Tour through the Taurida.

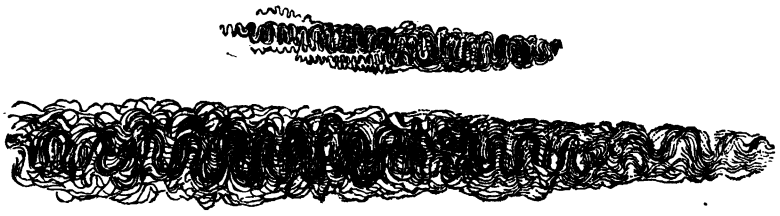
The first improvement consisted in substituting a sitting posture for an erect one, thus enabling the work-people to perform their task more rapidly and with greater ease. Mr. Pennant gives the following account of this as he saw it performed in the Isle of Skye: "On my return I am entertained with a rehearsal, I may call it, of the luagh or walking of cloth. Twelve or fourteen women, divided into two equal numbers, sit down on each side of a long board, ribbed lengthwise, placing the cloth upon it. First they begin to work it backwards and forwards with their hands, singing at the same time: when they have tired their hands every female uses her feet for the same purpose, (still sitting,) and six or seven pair of naked feet are in the most violent agitation, working one against the other. As by this time they grow very earnest in their labours, the fury of their song rises; at length it arrives at such a pitch, that without breach of charity you would suppose a troop of female demoniacs to have assembled*."

The practice of making cloth by the felting process was not soon superseded by the invention of weaving, even among the most polished people. Pliny thus speaks of its continuance in his time: "Moreover, wool of itself driven into a felt without spinning or weaving, serveth to make garments with; and if vinegar be used in the working of it, such felts are of good proof to bear off the edge and point of the sword; yea, and more than that, they will check the course of fire †."

The felting property of wool may be defined to be a tendency in the fibres to entangle themselves together, and to form a mass more or less difficult to unravel. The consideration of the causes of the felting of wool will lead to the explanation of other differences, and those the most important and characteristic, in the structure of that material.

### THE SPIRALLY-CURLING FORM OF WOOL.

The most evident distinguishing quality between hair and wool is the comparative straightness of the former, and the crisped or spirally-curling form which the latter assumes. If a little lock of wool is held up to the light, every fibre of it is twisted into numerous minute corkscrew-like ringlets. This is seen especially in the fleece of the short-woolled sheep; but, although less striking, it is obvious even in wool of the longest staple. The subjoined cut will sufficiently illustrate this point.



The upper figure represents a lock of Saxon wool; the lower one is the delineation of a lock of Leicester wool, from a sheep of the improved breed.

* Pennant's Tour to the Hebrides.

† Pliny, Nat. Hist., Book VIII. Ch. 48. The author speaks of the use of felted goods a very little before his time, even among the higher classes of society in Rome. "As or our mantles, frized deep both within and without, they were invented, and came to use first, no longer since than in my father's days, as also those hairy counterpanes and carpets: for the stuffed cassocks that senators and noblemen of Rome do wear begin but newly to be woven."—Ibid.

The spirally-curling form of wool used, but erroneously, to be considered as the chief distinction between the covering of the goat and the sheep; but the under coat of some of the former is finer than any sheep, and it is now acknowledged frequently to have the crisped and curled appearance of wool. In some breeds of cattle, particularly in one variety of the Devons, the hair assumes a curled and wavy appearance, and a few of the minute spiral ringlets have occasionally been seen. It is the same with many of the Highlanders, but there is no determination to take on the true crisped character and throughout its whole extent, and it is still nothing but hair. On some foreign breeds, however, as the yak of Tartary, and the ox of Hudson's Bay, some fine and valuable wool is produced.

There is an intimate connexion between the fineness of the wool and the number of the curves, at least in sheep yielding wool of nearly the same length; so that whether the wool of different sheep is examined, or that from different parts of the same sheep, it is enough for the observer to take notice of the number of curves in a given space, in order to ascertain with sufficient accuracy the fineness of the fibre. M. Lafoun has published an account of the management of the German Merino sheep at Hohenheim in Wurtemburg, and Schleisheim near Munich. He says that the whole flock is inspected three times in the year—before winter, when the selection of lambs is made, in the spring, and at shearing time. Each sheep is placed in its turn on a kind of table, and examined carefully as to the growth, the elasticity, the pliability, the brilliancy, and the fineness of the wool. The latter is ascertained by means of a micrometer. It being found that there was an evident connexion between the fineness of the fibre and the number of the curves, this was more accurately noted, and the following table was constructed. The fleece was sorted in the manner usual in France. The fineness of the superelecta, or picklock, is represented by a space corresponding with the number 7 on the micrometer; if this is (which will hereafter appear to be the case) equivalent to 1-840th part of an inch, and that fibre contains from 27 to 29 curves, the table will easily be understood:—

| Sort. | Name. | Curves in an inch. | Diameter of fibre. |
|---|---|---|---|
| 1 | Superelecta | 27 to 29 | 7 or 1-840th of an inch. |
| 2 | Electa | 24 to 28 | 8 or 1-735th " |
| 3 | Prima | 20 to 23 | 9 or 1-660th " |
| 4 | Secunda Prima | 19 to 19 | 10 or 1-588th " |
| 5 | Secunda | 16 to 17 | 11 or 1-534th " |
| 6 | Tertia | 14 to 15 | 11½ or 1-510th " * |
| 7 | Quarta | 12 to 13 | |

Sufficient attention has not been paid by the breeder to this curled form of the wool. It is, however, that on which its most valuable uses depend. It is that which is essential to it in the manufactory of cloths. The object of the carder is to break the wool to pieces at the curves—the principle of the thread is the adhesion of the particles together by their curves; and the fineness of the thread, and consequent fineness of the cloth, will depend on the minuteness of these curves, or the number of them which are found in a given length of fibre.

The wavy line in the above cut has a pretty appearance, even in the Leicester; but the close spiral curls of the Saxon wool deserve particular attention. The person most uninformed on these subjects will see at once why the Leicester wool is unadapted to clothing purposes. The particles into which it is broken by the card could have little or no coherence—the greater part would be dissipated in the operation—and the remaining por-

* Annales de l'Agriculture Française, 1832.

tions could not be induced so to hook themselves together as to form a thread possessing the slightest degree of strength. On the other hand, the close curls of the Saxon explain the reason why, on one account at least, it is placed at the head of clothing wools.

It will readily be seen that this curling form has much to do with the felting property of wool. It materially contributes to that disposition in the fibres which enables them to attach and entwine themselves together; it multiplies the opportunities for this interlacing, and it increases the difficulty of unravelling the felt. Still, however, it is only that form of the fibre which affords the fairest opportunity for the exertion of the true felting power. It assists, and very effectively, in producing the phenomena of felting, but it is not the principal agent concerned.

### THE FELTING PROPERTY OF WOOL RESUMED.

A reference to some well-known process in the manufacture of wool will be advantageous. The hatter takes a certain quantity of wool cut into short lengths, and with an instrument resembling a bow, he beats and tosses them about until he has completely separated them from each other, and they lie in all kinds of directions, and he has got a layer of them of sufficient thickness for his purpose. He then moistens them and covers them with a cloth, and presses them and moves them about backwards and forwards in every direction, until he finds that they are working themselves into a compact mass. In proportion as this mass is formed, he increases the pressure until it acquires the firmness that he wishes.

The cloth merchant weaves his cloth; but he has been compelled to use a considerable quantity of oil in the manufacture of it which must be got rid of; and, at the same time, his fabric is too open and the threads are too apparent to suit with the fashion of the times, or to be as smooth and soft and comfortable in wearing as it is required to be. He sends it to the fulling mill. It is put into a large trough with water, in which some argillaceous earth has been dissolved, and which combines with the oil, and gets rid of it in the form of soap. In order that this argillaceous earth may penetrate every part of the cloth, and every particle of the grease be removed, the fabric is passed rapidly and repeatedly through tight rollers, and then, fresh water being let in upon the cloth, (the process through the rollers still continuing,) it is washed perfectly clean.

The cloth is now put into the fulling-mill or stock, a certain quantity of soap being first carefully and evenly laid on it. By the joint influence of the moisture and the pressure, certain of the fibres of the wool are brought into more intimate contact with each other; they cohere: not only the fibres but, in a manner, the threads cohere, and the cloth is taken from the mill shortened in all its dimensions; it has become a kind of felt, for the threads have disappeared, and it can be cut in every direction with very little or no unravelling; it is altogether a thicker, softer, warmer fabric.

One more illustration from domestic life. The worsted stockings and the flannels!—for a while after their purchase they are observed to undergo a slow process of shortening or contracting every way at each washing; but the good housewife, taking care that they shall never soak long in water, and that no very hot water shall, by any chance, come in contact with them; and that, a liberal quantity of soap being allowed, they are washed as quickly as it can be effectually done, and immediately wrung well, and heartily shaken and stretched, and suspended by their extremities, instead of being carelessly thrown across the line—contrives they shall be tolerably worn out before they shrink to any inconvenient degree. In her absence, however, or contrary to her directions, the washerwoman, in

order to save herself some labour, suffers them to soak during some hours in hot water, or perhaps boils them. The immediate consequence of this is, that they all at once shrink to such an extent as to be nearly or quite useless; and when the articles are examined the threads are found to have been brought closer together, the material has been thickened, and a kind of matted or felted substance has been produced.

### THEORIES OF FELTING.

Many an ingenious theory has been brought forward in order to account for this process. To the natural philosopher nothing was more easy of explanation. It was the attraction of cohesion; it was that power by which the particles of all bodies, when brought within insensible distances, are held together; it was an illustration of that universal law by which the system rolls entire. Take two leaden bullets; scrape a small portion from each; bring the smooth surfaces, although but of little extent, together; press them together with a kind of twist, and they cohere. Bring two plates of glass together perfectly level and clean, and they will adhere with considerable force. So the fibres of the wool, in these manipulations, were supposed to be brought within the sphere of each other's attraction, and to have cohered. "The reason of the contraction of the cloth in felting," says Dr. Young, "is probably this, that all the fibres are bent by the operation of the hammers but not equally, and those that have been the most bent are prevented by their adhesion to the neighbouring fibres from returning to their original length."* In another place his language is stronger and more intelligible. "Monge thinks that the hairs are united by projecting serrations or filaments; but this supposition is not necessary in explaining the adhesion of felts, which may be deduced from the force of friction alone."† Mr. Luccock is inclined to adopt this opinion. He says, "We know too little at present to enable us to assign the cause of this permanent contraction; but conjecture that it is owing to the particles of the thread which are brought into actual contact with each other, cohering exactly upon the same principle as the leaden balls do in the common experiment, so often exhibited in lectures upon natural philosophy to illustrate the attractive power of bodies."

It was forgotten, however, that this attraction of cohesion can take place only at insensible distances, and that the interposition of the smallest substance, a single hair, or the minutest film of water, prevented the display of it; yet the felting property of the wool, if the presence of moisture were not absolutely necessary to it, was best displayed when the fabric was immersed in water. There was no answer to this, and the philosophical explanation of the felting of wool was abandoned by every practical man.

The presence of some fluid is connected with the usual development of the felting property. It was said to be the effect of moisture to shorten both the vegetable and animal fibre. This, however, is not the fact; single filaments, whether vegetable or animal, lengthen under the influence of moisture. The hygrometer is sometimes composed of a single hair attached to a delicate string; and even a collection of straight fibres obey the same law. The husk of the oat—the principle of the weather-house—is an illustration of this; a leathern thong also is extended by being wetted. The moisture enters into the pores of these bodies, and forces the particles of which they are composed farther from each other.

On a twisted cord the effect is different; by the very entrance of the moisture between the pores of the fibres of which the cord is composed, the

* Young's Natural Philosophy, vol. i. p. 186.
† Ibid., vol. ii. p. 190.

diameter of each coil must be increased and the cord must consequently be shortened. The village hygrometer—no bad indicator of the weather—the piece of cord that has been soaked in salt water, and the little weight appended to the centre of it, will illustrate the present subject. When the air is parting with a portion of its water, and rain is likely to follow, the salted cord absorbs the moisture and contracts, and the weight rises. So also the *animal* twisted fibre—the string of the violin, or of the piano-forte—contracts in wet weather so forcibly that it breaks. In this way the felting of the cloth in the fulling-mill, and the contraction of the flannel and the stocking, may be readily accounted for; the twisted thread does contract, its coils enlarge, and the whole is shortened. The manufacturer, therefore, very naturally calls in the aid of moisture, in order to increase the effect of his pressure and beating, or to commence that motion among the fibres of the wool which he afterwards carries to a greater extent.

Still the phenomena of felting are not accounted for. The weather becomes dry, and the husk of the oat again shortens, and the cord of the village hygrometer lengthens, and the weight again descends, the string of the musical instrument, if it has not been broken by the violence of the contraction, lengthens and gives a graver sound; but nothing can restore the former length and elasticity of the stocking, or unravel the felting of the hat or the cloth. The forming of these dense masses may have been assisted by the action of moisture and pressure and beating on the woolly fibre or the threads or little accumulations of it, but there is another principle at work for which search must be made.

### A GLIMPSE AT THE TRUE PRINCIPLE.

There is one circumstance of very common observation: if a filament, or a small collection of filaments of the finest wool, is drawn through the finger and thumb, in a direction from the root to the extremity, it is evident that the surface of the fibre is smooth and polished; but if the direction is reversed, a little more force is requisite, and it seems as if some rough, and bristled, and serrated body were drawn through. This simple experiment has been made a thousand times, and invariably with the same result; yet when the fibre was examined by means of the best microscope, not the slightest irregularity of surface could be discovered.

It could not, however, be doubted that this peculiar sensation communicated to the fingers, when a fibre of wool or hair was drawn between them in a direction from the extremity to the root, was connected with the felting property of wool; and a few of those who were concerned with the manufacture of this material, and some philosophic inquirers who condescended to apply the principles of science to the elucidation of facts so humble as this, anxiously employed themselves in developing the principle on which the felting of wool was founded.

Mr. Bakewell imagined that the roughness, or tremulous motion felt in drawing a hair through the fingers, might "be caused by minute vibrations, more easily excited in one direction than another, owing to the peculiar arrangement of the particles, or of the small filaments which compose the substance of wool or hair." This motion he compared to that of an "ear of barley placed under the sleeve of the coat, with the points of its beards downwards. By the action of the arm the ear is moved in a retrograde direction, until it has advanced from the wrist to the shoulder *."

It is sufficient to observe that this account of the matter is exceedingly

* Bakewell on Wool, p. 105.

unsatisfactory. It explains neither the cause of the vibrations, nor the facility with which they are propagated in one direction rather than another; and the uniform progression of the ear of barley, in a direction from the point to the base has nothing to do with any vibratory motion whatever. The extremities, or the serrated edges of the beard, entangling with the clothes, or burying themselves in the flesh, forbid any progression forward, when, by every action of the arm, the ear is pressed between it and the clothes, and it elongates in the direction of the stem alone, where there is no opposition. The pressure ceasing, and the ear, by means of its inherent elastic power, recovering, or endeavouring to recover, its former curved form, is drawn back a portion of the way that it had travelled, but the beard is also drawn forward, neither the points nor the serrated edges now offering opposition, and thus a little ground is gained; and by the repeated action of the arm, the barley travels in a direction towards the stem. This onward journey of the ear, in one direction only, and that with the root forwards, is attributable to the points and serrated edges of the beard, and to them alone.

Reflections of a similar nature induced those who had anxiously studied the phenomena of felting to imagine that the fibres of wool, when brought into close contact with each other, moved with facility in one direction alone; and having been pressed to a certain distance into a mass of other fibres, were in a manner fixed there: and they thought that they could best, or could only account for this, by the supposition that the fibres had an irregular and serrated surface.

"Respecting," says Mr. Thomas Plint, in a letter to the author, "the application of the microscope to the examination of the fibre, I am decidedly of opinion that a careful and minute examination of wools differing in their felting properties would issue in the detection of some specific difference of structure. This property is altogether inexplicable, at least in my mind, except on the supposition that the extreme surface of the fibre is irregularly *feathered*, and that, by compression, these feathered edges become entangled and locked together. These feathers must also point in one direction, viz., from the root to the extremity of the fibre; and if we suppose the feathered edge, or, more properly speaking, the individual tooth or feather, to be of a firm texture, it is evident that one tooth being pushed into another, would fasten like a wedge; and if we further suppose that the tooth or feather has a barb, similar to that on a whale-harpoon, the phenomena of felting are explained."

M. Monge, a French chemist, was the first who ventured to assert that this must be, and is, the actual structure of wool; that "the surface is formed of lamellæ, little plates which cover each other from the root to the point, pretty much in the same manner as the scales of a fish cover that animal from the head to the tail, or like rows placed one over the other, as is observed in the structure of horns*." Considering this to be not only probable, but in a manner certain, he goes on to describe the mechanism of felting as accurately as if he had seen the serrated edge of the wool. The workman is supposed to be preparing to make the felt which is to constitute the substance of the hat. "He presses the mass with his hands, moving them backwards and forwards in various directions. This pressure brings the hairs against each other, and multiplies their points of contact. The agitation gives to each hair a progressive motion towards the root; but the roots are disposed in different directions—in every direction; and the lamellæ of one hair will fix themselves on those of another hair, which happens to be directed a contrary way, and the hairs become twisted toge-

* Annal. de Chimie, vol. vi. p. 300.

ther, and the mass assumes that compact form which it was the object of the workman to produce. In proportion as the mass becomes compact, the pressure of the hands must be increased, not only to make it closer, but also to keep up the progressive motion and twisting of the hairs which then takes place with greater difficulty. Throughout the whole of this operation the hairs fix themselves only to each other, and not to the cloth, the fibres of which are smooth, and not disposed to felting."

One extract more from Monge, for he should not be robbed of a particle of the honour which is his due. The cloth is supposed to be carried to the fulling-mill. "The scouring of the cloth is not the only object in fulling it. By the alternate pressure given by the mallets to a piece of cloth, especially when the scouring is pretty far advanced, an effect is produced analogous to that of the hands of the workman on the felt of the hat. The fibres which compose one of the threads, whether of the warp or the woof, assume a progressive movement; they introduce themselves among those of the threads nearest to them, and thus by degrees all the threads become felted together, the cloth is shortened in all its dimensions, and partakes both of the nature of cloth and of felt*."

### MICROSCOPIC APPEARANCE OF HAIR AND WOOL.

Since the arrangement of the lenses in the achromatic microscope has so much increased the power of defining, if not of magnifying things by means of that instrument, the intimate structure of many interesting objects has been discovered and depicted. The long hair of the bat has exhibited a cylinder, round which a spiral projection has run like a riband, from the root to the extremity. The shorter hair or fur, or, more properly speaking, wool of the same animal, has been shown to resemble a succession of joints in the form of inverted cones—the apex of the superior one being

* This explanation of the felting principle was, however, far from being generally received by the French philosophers, MM. Perrault de Jotemps, Fabry, and Girod de l'Ain, in their work on wool already referred to (p. 68), bring forward a very different and unsatisfactory theory. "Felting," say they, "is the property which certain hairs and vegetable filaments have of attaching themselves more and more to each other in proportion as the fabric in which they are united is beaten. The action of the hammers produces three effects—to straighten, to force out, or to break the filaments of which it is composed; the consequence of which is the development of that kind of elasticity which consists in the disposition or attempt of the fibre to regain its previous undulated form—that elasticity by which it returns to its original length, and especially excited by the fragments when the fibre is broken under the hammer. The effect of the hammer will be felt by the fibres in the interior of the thread. The hammer being raised, they will endeavour to regain their previous form; and the various circlets all acting under the influence of the same principle of elasticity, will entangle themselves with one another; and so the felting process will commence in the centre of the thread. In the same way, the outer filaments, compressed and lengthened under the hammer, will unite with each other, as, by their elastic power they are endeavouring to regain their former shape; and, the threads being close to each other, the filaments of one will become entangled with those of its neighbour, and thus felting will extend through the whole substance of the cloth. If it should so happen that any of the filaments are broken by the hammers, the felting power will be more strikingly apparent; for the fragments, loosened from their adhesions, and springing into their former curves, cannot fail of entangling themselves intimately and deeply with all the particles around them."—*Nouveau Traité*, p. 52.

Felting, then, according to these gentlemen, depends on the curved form of the wool, and the elastic principle by which it endeavours to regain that form, after having been straightened under the hammer. The curved form of wool doubtless assists materially in the production of felting, for it multiplies the opportunities for the entanglement of the fibres; and the tendency to take on again the crumple shape, when that has been forcibly changed, is another agent to which much may fairly be attributed: but these will not alone satisfactorily account for the phenomena that take place. They afford, as has been already observed, opportunity for the exertion of the felting power; but that power is yet to be sought for, or was first rightly guessed at by Monge.

received into the cup or half-excavated base of the inferior one: and thus most satisfactorily accounting for the great pliability of this material, and for the perfection of its felting property when tried on the small scale of which it is capable. This is plainly shown in the first figure of the cut at p. 88.

The hair of the human being has been very carefully examined. Mr. Gill gives a figure of it, as being of a cylindrical form, and covered with scales or roughnesses *; but Dr. Goring thus describes it:—"a hair viewed on a dark ground is seen to be indented with teeth, somewhat resembling those of a coarse, round rasp, but extremely irregular and rugged. These incline all in one direction like those of a common file,—viz., from the origin of the hair towards its extremity †," thus accounting well for the occasional harling or matting of the hair when subject to pressure, especially towards the poll of the head. It is to be regretted that Dr. Goring did not make a drawing of this appearance of the hair; for his account of it would then have had much greater weight. It is singular that, although nine years have passed, and the microscope has been considerably improved since Dr. Goring observed this structure of the hair, and almost every one who possessed an instrument of much power has been eager to gaze on this new discovery, no person has been so fortunate as to detect a single serration on its edge.

These philosophers, however, seem scarcely to have directed their examinations and inquiries to those useful purposes which ought at once to have suggested themselves to their minds. The fur of the mouse, with its singular openings through the external crust,—the inverted cones of the bat were admired; but the woolly covering of the sheep, the basis of the staple manufacture of the kingdom,—evidently possessing such different properties in different breeds, and producing fabrics so strangely different in their substance and their use,—attracted no attention. It would have been unpardonable if the writer of this treatise had not anxiously inquired what assistance could be derived, by means of the newly improved optical instruments, on these points of paramount importance,—the intimate structure of the filaments of wool—the possibility of obtaining a clue to the cause of the felting property generally, and the various degrees in which it existed in the numerous domestic and foreign breeds.

### THE DISCOVERY OF THE IRREGULAR SURFACE OF THE WOOL.

Although the microscope which he used was well constructed, and of great power, and the optician to whom it belonged had the kindness to superintend the adjustment of the lenses and the objects and the more difficult management of the light, the author was completely disappointed in his first attempts to discover the minute structure of the fibre. Nothing was to be seen but a semi-transparent polished trunk, with a few branches sprouting from it, and beautifully reflecting the light,—a little larger in some places than in others, and particularly where these branches sprouted; there were several wavy, indistinct marks, but not sufficient to authorize him to conclude, or even suspect, that they were connected with irregularities, much less serration of surface. He tried various wools—those remarkable for their felting property, and others that possessed it in a much slighter degree,—and there was no difference but in the bulk of the fibre, the degree of transparency, and the occasional enlargements of the trunk where the offsets grew. After having wearied the optician and himself, the author retired, having previously obtained a promise from this gentleman that he would subject the fibres to the test of another instrument possessing

* Gill's Technological Repository, vol. iv. p. 130.
† Brande's Quarterly Journal, 1826, p. 433.

even superior power of defining objects. A few days afterwards he had the mortification to receive a letter from the optician, containing the following passage:—"Agreeably to your request, I have again examined the specimens of wool, and with a still higher power than when you were here. The result is precisely the same; there is no appearance whatever of indentations upon the edges, and the only difference I found was, that the markings we observed upon the surface were more distinctly made out, and had more the wavy appearance than before. I am satisfied that the hair is round and cylindrical. If there were any indentations upon the edges, they would surely be seen by the microscope I now used."

The author would now have probably relinquished the inquiry in despair, and contemplated this portion of his subject as necessarily unsatisfactory, and probably erroneous. Speculation—perhaps idle, and unsubstantial theory—would mingle with that which ought to be a plain narration of facts. In the mean time, however, he had been introduced to an artist extensively engaged in the manufacture of achromatic microscopes, the lenses of which were ground and polished under his own immediate inspection—Mr. Powell, of Clarendon-street, Somers Town, London. With much good nature he devoted a portion of his valuable time to the pursuit of this new inquiry; and, after various trials, and much skilful management, succeeded in displaying the irregular edges of a fibre of Merino wool. The power which was then used was not sufficiently high; and, although the serrated edge was evident—it was impossible that we could be deceived—yet the irregularities were minute, and the outline faint. The further examination of the subject was adjourned until a lens had been procured of less focal distance and greater defining power.

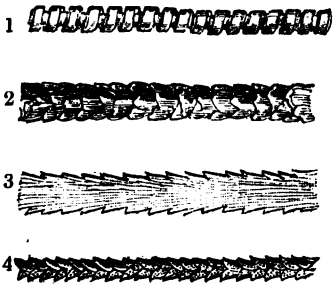
### THE FIRST PUBLIC VIEW OF THE SERRATED EDGE OF WOOL.

The author of this work may have formed somewhat too sanguine expectations of the important consequences that will result from the discovery of the structure of the fibre of wool; at all events, he is anxious to place the record of it beyond the possibility of denial or doubt.

On the evening of the 7th of February, 1835, Mr. Thomas Plint, woollen manufacturer, resident at Leeds; Mr. Symonds, clothing agent, of Cateaton-street, London; Mr. T. Millington, surgeon, of London, an esteemed friend; Mr. Edward Braby, veterinary surgeon, at that time assisting the author in his practice; Mr. William Henry Coates, of Leeds, veterinary pupil; Mr. Powell, the maker of the microscope, and the author himself, were assembled in his parlour. The instrument was, in Mr. Powell's opinion, the best he had constructed; he had sold it to a gentleman, but now borrowed it for this purpose. A fibre was taken from a Merino fleece of three years' growth; the animal was bred by and belonged to Lord Western. It was taken without selection, and placed on the frame to be examined as a transparent object. A power of 300 (linear) was used, and the lamp was of the common flat-wicked kind. The focus was readily found; there was no trouble in the adjustment of the microscope; and, after Mr. Powell, Mr. Plint had the first perfect ocular demonstration of the irregularities in the surface of wool,—the palpable proof of the cause of the most valuable of its properties,—its disposition to felt.

The fibre thus looked at assumed a flattened riband-like form. It was of a pearly grey colour, darker towards the centre, and with faint lines across it. The edges were evidently hooked, or more properly, serrated—they resembled the teeth of a fine saw. These were somewhat irregular in different parts of the field of view, both as to size and number. The area of the field was now ascertained; it was one-fortieth of an inch in dia-

meter. By means of the micrometer we divided this into four, and we then counted the number of serrations in each division. Three of us counted all four divisions, for there was a difference in some of them. The number was set down privately, and it was found that we had all estimated it at fifteen in each division. Having multiplied this by four, to obtain the whole field, and that by forty, the proportionate part of an inch of which the field consisted, we obtained a result which could not be disputed, that there were 2400 serrations in the space of an inch, and all of which projected in the same direction, viz., from the root to the point. Then, before we quitted the examination of the fibre as a transparent object, we endeavoured to ascertain its actual diameter, and proved it to be $\frac{1}{750}$th of an inch.




[*The Bat's Hair and Wool. The Long Merino Wool.*]

1. The hair of a bat, as exhibited by the microscope.
2. The wool of do.
3. A fibre of long Merino wool, viewed as a transparent object.
4. Ditto, as an opaque one.

We next endeavoured to explore the cause of this serrated appearance, and the nature of the irregularities on the surface, which might possibly account for the production of these tooth-like projections; we therefore took another fibre, and mounted it as an opaque object. There was considerable difficulty in throwing the light advantageously on the fibre, so small a space only as $\frac{1}{80}$th of an inch intervening between the lens and the object. At length Mr. Powell perfectly succeeded, and we were presented with a beautiful glittering column, with lines of division across it, in number and distance seemingly corresponding with the serrations that we had observed in the other fibre that had been viewed as a transparent object. It was not at once that the eye could adapt itself to the brilliancy of the object; but by degrees these divisions developed themselves, and could be accurately traced. These were not so marked as the inverted cones which the bat's wool presented, but they were distinct enough; and the apex of the superior one, yet comparatively little diminished in bulk, was received into the excavated base of the one immediately beneath, while the edge of this base formed into a cup-like shape, projected, and had a serrated, or indented edge bearing no indistinct resemblance to the ancient crown. All these projecting indented edges pointed in a direction from root to point.

Whether these, like the cones of the bat, are joints, or at least points of comparative weakness, and thus accounting for the pliancy and softness of the fibre, or regulating the degree in which these qualities exist, may perhaps be better determined by and by: one thing, however, is sufficiently

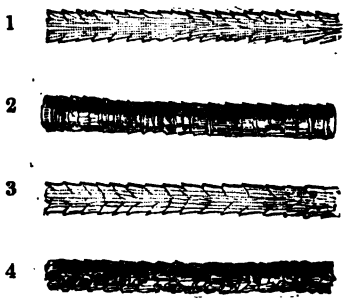
plain, that these serrated edges in the transparent object produced (when the fibre was resolved into its true form as an opaque one) by the projecting edges of the cups, or hollowed bases of the inverted cones, afford the most satisfactory solution of the felting principle that can be given or desired. The fibres can move readily in a direction from root to point, the projections of the cups offering little or no impediment, but when they have been once involved in a mass, and a mass that has been pressed powerfully together, as in some part of the manufactory of all felting wool, the retraction of the fibre must be difficult, and in most cases impossible *.

### THE USE OF THE MICROSCOPE EXTENDED.

The felting property of wool is the most important as well as the distinguishing one; but it varies essentially in different breeds, and the usefulness and the consequent value of the fleece, at least for clothing purposes, depends on the degree in which it is possessed. Will our microscopical observations be useful here? It is a very curious and interesting point that has been established,—the existence of an irregularity of form in the wool, accounting for and necessarily giving it a felting power,—is there a variation in this structure corresponding with the degree of felting power? If there is this difference in the form of the fibre, a method has been discovered, expeditious and certain, and superior to any yet known, of judging of the qualities of different samples of wool,—or rather, it is the only mode by which those properties of wool, on which its value chiefly depends, can be thoroughly ascertained. This inquiry was commenced very cautiously, and with a degree of anxiety of which the reader will now be able to form some adequate conception.

### COMPARISON OF THE STRUCTURE OF DIFFERENT WOOLS WITH THE FELTING PROPERTY.

A fibre of Saxon wool was set up as a transparent object. This sheep is originally a Merino, but the fleece is much improved by careful management. Its felting property is superior to that of the Merino, and for some purposes it is more highly valued. The following cut exhibits the result.




[*Saxony Wool.*]

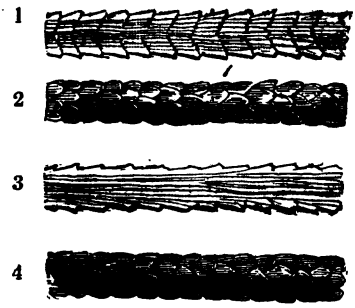
1. A fibre of Saxon wool as a transparent object.
2. Ditto, opaque.
3. Ditto, combed, transparent.
4. Ditto, combed, opaque.

* The discovery of the real structure of wool will throw much light on a circumstance familiar to every reader, viz., the different sensation imparted by the contact of linen and woollen cloths with the skin. No one would be so absurd as to apply flannel to a woun

It is evidently a finer wool than the Merino; it is $\frac{1}{840}$th part of an inch in diameter. The serrations are as distinct; they are not quite so prominent, yet there is not much difference in this respect, and certainly not greater than the difference in the bulk of the fibre would produce. There is a little more irregularity in the distribution of the serrations; and after careful counting, there is an average of seventeen in each of the four divisions of the fibre. This number multiplied by four will give sixty-eight as the whole number in the field of view, and that multiplied by forty will yield a product of 2720, the number of irregularities in the edge of the fibre in the space of an inch.

It is next viewed as an opaque object, and presents nearly the same appearance as the long Merino. The cups answer in number to the serrations, their edges project, and there is also an indication of a serrated edge; but as the fibre, and consequently the cup is smaller, it is not so deep as in long Merino.

The next cut gives the microscopical appearance of some South Down wool of a very fair and good quality. This is an exceedingly useful wool; but, on account of its inferior felting power, rarely used in the manufacture of fine cloths; in fact, it has been superseded by that which has been just described, and others of a similar quality.




[*South Down Wool.*]

1. A fibre of South Down wool as a transparent object.
2. Ditto, ditto, as an opaque.
3. Ditto, combed, transparent.
4. Ditto, combed, opaque.

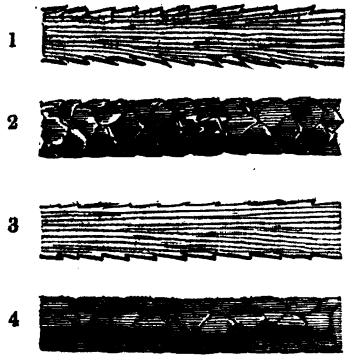
The fibre is evidently larger; it is the $\frac{1}{660}$th part of an inch. The serrations differ in character; these are larger, but they are not so acute, they almost appear as if they had been rounded; they have a rhomboidal, and not a hooked character, and they are evidently fewer in number in the same space. There are thirteen in each division, making, according to the mode of multiplication already pursued, 2080 serrations in an inch, or 640 less than the Saxon.

It is made an opaque object; the cups answer in number to the serra-

or excoriated surface; not from any chemical effect that the wool has on the sore, but because the sharp and hooked edges, furrowing the wound, could not fail of increasing the irritation of the part to a painful and dangerous degree. It will no longer be surprising that new flannel, and especially when manufactured from a harsh species of wool, is often so unpleasant to wear, until either the skin gets accustomed to the irritation of all these protruding hooks, or they are gradually blunted or broken off. The advantage frequently derived from wearing flannel will also be apparent, for the *carding* produced by all these tiny points cannot fail of producing a glow on the skin, and a healthy determination of blood to it.

tions; they are more regularly distributed,—they are not so prominent; and they show, what is now seen for the first time—the fibre being larger—that the cup is not composed of one continuous substance, but of numerous leaves, connected together, and probably overlapping each other. The serrations which were observed in the edge of the cups in the long Merino and the Saxon, are here resolvable into small leaves (three are visible); the vacancy, or angle between the tops of them not being of any considerable depth.

The next wool that was subjected to examination was the Leicester; the unrivalled British long wool, and as useful, as indispensable for some purposes, as the finer wools already described are for others; and possessing, and therefore the better adapted for its own purposes, the felting property, to a comparatively little extent.




[*The Leicester Wool.*]

1. A fibre of Leicester wool, as a transparent object.
2. Ditto, ditto, an opaque one.
3. Ditto, combed, transparent.
4. Ditto, ditto, opaque.

The fibre is considerably larger; it is $\frac{1}{800}$th of an inch. On account of its bulk, the little wavy lines about it give more decided indications of irregular external structure. The serrations are superficial,—irregular, differently formed in different parts—a few like small spines, not projecting far from the surface, but running along it; other prominences are more rounded, and occasionally they give the idea of lying one upon another, as if two rods had been spliced together, with the end of one projecting beyond the other. They were evidently fewer in number; each quarter of the field contained but eleven, amounting to only 1860 in the space of an inch, or 220 less than the Southdown.

As an opaque object, the cups corresponded in number with the serrations and the construction of the cup is more evident. It consists of from four to six leaves, rounded at the extremity, and with only a short point or spine protruding, and the leaves evidently lying closer to the body of the fibre.

## CONCLUSIONS.

There can no longer be a doubt with regard to the general outline of the woolly fibre. It consists of a central stem or stalk, probably hollow, or at least porous, and possessing a semitransparency not found in the fibre of hair. From this central stalk there springs at different distances, in different breeds of sheep, a circlet of leave-shaped projections. In the finer species of wool these circles seemed at first to be composed of one indented,

or serrated ring; but when the eye was accustomed to them, this ring was resolvable into leaves, or scales. In the larger kinds the ring was at once resolvable into these scales, or leaves, varying in number, shape, and size, and projecting at different angles from the stalk, in the direction of the leaves of vegetables, from the root to the point, or farther extremity. In the bat there seemed to be a diminution in the bulk of the stalk, immediately above the commencement of the sprouting of the leaves, and presenting the appearance of the apex of an inverted cone received in the hollowed cup-like base of another immediately beneath. The diminution in the fibre of the wool at these points could be only indistinctly perceived; but the projection of the leaves gave a somewhat similar cone-like appearance. The extremities of the leaves in the long Merino and the Saxon wool were evidently pointed, with acute indentations or angles between them. They were pointed likewise in the Southdown, but not so much, and the interposed vacuities were less deep and angular. In the Leicester the leaves are round, with a diminutive point or space. Of the actual substance and strength of these leafy or scaly circles nothing can yet be affirmed; but they appear to be capable of different degrees of resistance, or of entanglement with other fibres, in proportion as their form is sharpened, and they project from the stalk, and in proportion likewise as these circlets are multiplied. So far as the examination has hitherto proceeded, they are sharper and more numerous in the felting wools than in others, and in proportion as the felting property exists. The conclusion seems to be legitimate, and indeed inevitable, that they are connected with, or, in fact, that they give to the wool the power of felting, and regulate the degree in which that power is possessed.

If to this is added the curved form which the fibre of the wool naturally assumes, and the well-known fact, that these curves differ in the most striking degree in different breeds, according to the fineness of the fibre, and, when multiplying in a given space, increase both the means of entanglement and the difficulty of disengagement, the whole mystery of felting is unravelled. A cursory glance will discover the proportionate number of curves, and the microscope has now established a connexion between the closeness of the curves and the number of the serrations. The Saxon wool is remarkable for the close packing of its little curves; the number of serrations are 2720 in an inch. The South Down wool has numerous curves, but evidently more distant than in the former sample; the serrations are 2080. In the Leicester the wavy curls are so far removed from each other, that a great part of the fibre would be dissipated under the operation of the card, and the serrations are 1860; and in some of the wools which warm the animal, but were not intended to clothe the human body, the curves are more distant, and the serrations are not more than 480. The wool-grower, the stapler, and the manufacturer, can scarcely wish for better guides.

Yet there is no organic connexion between the curve and the serration; the serrations are not the cause of the curve, nor do the curves produce the serrations; the connexion is founded on the grand principle that the works of nature are perfect, that no beneficial power is bestowed without full scope for its exercise. The curves of the smooth fibre might entangle to a considerable degree, but some of the points would be continually unravelling and threatening the dissolution of the whole felt. The straight fibre, however deeply serrated, its root being introduced into the mass, would often pass on and pass through the felt and be lost. It is by the curved form of the jagged fibre that the object can be accomplished certainly and perfectly.

Future observers may possibly detect in wool the apparent coned and

jointed structure of the hair of the bat, and then a third and powerful principle would be called into action, the pliability of the fibre, the ease with which it is bent in every different direction, and in each becomes more inexplicably entangled. A great point, however, is gained by the knowledge that in proportion as the auxiliaries in the felting process are multiplied, the direct agents are also increased.

As the work proceeds, the author will endeavour to give the microscopic character of the wool of the different varieties of British sheep, and of most of the foreign ones; it will be for the breeder and the manufacturer to build on the foundation which he is attempting to lay, and to draw those practical and valuable inferences which such statements will naturally suggest *.

### OTHER WOOL-BEARING ANIMALS.

It has been stated (page 56) that the number of wool-bearing animals is much greater than has been commonly imagined. The consideration of the clothing of one or two of them, most frequently employed in the manufacture of certain articles of dress, will show the importance of the inquiry into the structure of wool, and the immense extent to which it may hereafter be carried.

The fur, as it is called, of the hare, the rabbit, the beaver, the otter, and a variety of animals, used in the manufacture of hats, and various other felts, is composed, like the covering of the wild or undomesticated or neglected sheep, of a mingled mass of hair and wool: the hair being of different lengths in different animals, but in all of them extending over, and lying upon, and protecting the wool; and the wool differing in length, closeness, and value in different animals, and differing as materially, or even more so, in the same animal, according to the season of the year, the degree of cold, and the general state of the weather. "The weather," says an intelligent writer, "has great influence on the quality and quantity of furs imported from all quarters of the globe; and this circumstance renders the fur trade more difficult, perhaps, and precarious, than any other: not only the quality, and consequently the price of many furs, will differ every year; but I have often seen the same article rise and fall 100, 200, and 300 per cent. in the course of a twelvemonth: nay, several instances in the space of one month only†."

* "I am of opinion," says Mr. Plint, in one of the kind and valuable letters which the author received from him, "that if you had samples of different species of wool, Saxony, Spanish, and Odessa, as foreign wools; and of Norfolk, Southdown, and Ryeland, as English wools, with an accurate statement of the respective properties of each, you might then, by a careful examination of the fibre, discover some peculiarity of structure on which the properties respectively depended. The greater your variety of wools, and the more accurate the description of the manufacturing properties, the more likely would you be to come at some general conclusions. For instance, I am inclined to think that you would find the felting properties greatest in wools the fibres of which had a great number of curves; and I apprehend, also, that the feathered, or jagged character of the fibre has a close connexion with the number and character of the curves."

The discovery has been made. Many pleasing feelings will be associated with the recollection of that evening when the serrated edge of the fibre of wool was first seen by a small circle of the author's friends, and among whom, as has been already stated, was Mr. Plint, who happened then to be in London. If a veterinary surgeon chanced to be the fortunate discoverer, why, it will show that he is, or is capable of being, far more intimately connected with the agriculture and the prosperity of his country, than many have supposed him to have been, or than perhaps he actually has been; and it will more plainly point out to him the path of duty. That path will be pursued in the present work, so far as opportunity will serve; but it will be for some more practical man (and who better than Mr. Plint himself ?) to take up the theme, and follow it through all its important, invaluable consequences.

† M'Culloch's Dictionary, Art. "Fur Trade."

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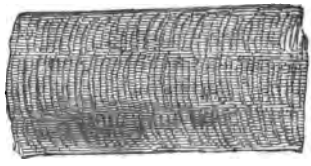


3

[*The Wool of the Rabbit.*]

**1. The wool of the rabbit opaque. 2. The hair of the rabbit, transparent. 3. Ditto opaque.**

This is selected, as most easy to be obtained, and the use of the fur being best known. When the skin is examined, the long, straight, strong, and yet fine and soft, hairs, constituting the apparent coat of the animal, are sufficiently evident; but when this external covering is blown aside, a shorter, softer, crisped, curved fibre is immediately perceived, with every characteristic of true and perfect wool.

These substances were put to the test of the microscope. The wool is beautifully fine. It does not exceed $\frac{1}{1000}$th part of an inch in diameter. The edges—the fibre being viewed as a transparent object—was decidedly serrated; the serrations are regular and sharp,—in a direction from root to point,—18 of them were found in each division of the field, and consequently there were 2880 in the space of an inch, being 160 more than in the highly felting and valuable Saxon wool. There were, however, comparatively few curves.

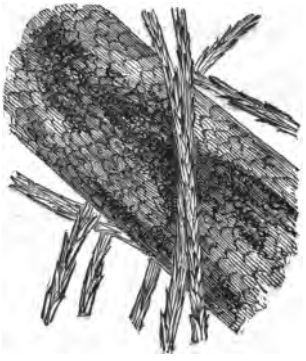
It was next viewed as an opaque object, and is depicted in the above cut —the cups answer in number to the serrations,—they extend horizontally across the fibre, and the upper edge is indented or crowned.

The hair varies in diameter from $\frac{1}{250}$th part to the $\frac{1}{800}$th part of an inch. The hair, as a transparent object, has a very clear outline, with some few faint cloudy irregularities on its surface, but without any serration—as an opaque object, it is covered with a scaly incrustation, but cannot be said to be serrated.

It is not for the author to pursue this inquiry to any greater extent, but when it has been determined on which of these substances the chief value of the skin depends, and by what circumstances the character and value of it is influenced or changed, it is easy to perceive what incalculable improvement may be introduced here by breeding and careful management, and how probable it is that this material may, in process of time, be devoted to purposes at present unthought of.

Another wool-bearing animal, a frequenter of the British coasts, is the seal. His coat is thus described in one of the most valuable of our works on Natural History :—" The hairs are all silken, flat, pointed, harsh, and

compact *." This is true of the external coat; but if this is turned aside, a variable quantity of wool is immediately discovered. No fewer than 748,785 of these skins were imported into Great Britain in 1831. In the specimen whence the hair and wool delineated in the annexed cut was taken —the yellow-spotted seal, often seen on the Dutch coast—the wool was abundant in quantity. The curves were not very thickly set, which induced the suspicion that serrations would not be numerous.



[*Seal's Hair and Wool.*]

It is viewed as an opaque object. The wool is exceedingly fine—not more than $\frac{1}{1250}$th part of an inch in diameter—and if other things had corresponded, it would have been invaluable, but the serrations were few and far between; they did not exceed three in each of the divisions, or 480 in an inch: they were little more than a sixth part as numerous as in the Saxony fleece, and the serrations were not of a decided character; it was more an overlaying, or splicing of the parts, and a hooked formation. The hair, $\frac{1}{140}$th of an inch in diameter, about nine times as much as the wool, forms a singular contrast with the wool. It is beautifully covered with scales, but there is not the vestige of a serration.

Two other cuts are given as illustrations of the previously unsuspected presence of wool in the coats of animals both wild and domesticated.

While the author was engaged in inquiries connected with this work, he observed a North American brown bear, in the gardens of the Zoological Society, changing a portion of his coat,—a matted substance was working its way through the hair, and became detached in large flakes. He secured one of these flakes, and found that it consisted chiefly of wool, in which a few hairs were involved. He wondered not at this, although no naturalist had spoken of the wool of the bear. It was the defence given by nature against the extreme cold to which this animal was necessarily exposed: it was evidently identified with the locality and the habits of the bear. It yet remains to be seen how far the skill and perseverance of the manufacturer will convert it, and that which is found on the back of many an animal that had not been dreamed of as a wool-bearer, to the purposes of man.

The author submitted it to the test of the microscope. It stood high in point of fineness. The diameter of the fibre was only the $\frac{1}{750}$th part of an inch,—the precise diameter of the Picklock Merino; but it had few curves, and few serrations,—four only in one of the divisions of the field, or 640 in an inch. These serrations had a curious character: they

* Griffith's Edit. of "Cuvier's Animal Kingdom," 8vo., vol. ii. p. 499.

resembled so many spires projecting at irregular distances, and at an exceedingly acute angle. The fibre here represented was viewed through lenses of a higher power, in order to bring out its peculiar structure.

[*Bear and Wolf-Dog's Wool.*]

1. The wool of the Bear. 2. Ditto, Wolf-Dog, transparent. 3. Ditto, opaque.

He did not, however, expect to find wool on the Italian wolf-dog. Although an inhabitant of the Alps, the individual from whose back he obtained the specimen had been domesticated in his native country, and, when afterwards removed to a more northern clime, had been sheltered from the vicissitudes of the weather. He, however, had a very considerable proportion of short wool beneath the hair. The curves, although few compared with those in the short-wooled sheep, were more than doubly as numerous as in the bear, and the serrations were increased in the same proportion. They amounted to nine in one of the divisions, or 1440 in an inch. Had the wool been long, it might have been said that it occupied an intermediate rank between the Leicester and the Lincoln, displaying somewhat fewer serrations than the former and more than the latter. The serrations were superficial and irregularly placed, some of them resembling small spines and others looking like rounded prominences. When viewed as an opaque object, the cup was composed of two and sometimes three leaves with rounded extremities.

The last illustrative cut that will be given represents the wool and hair of the tiger.

[*The Wool and Hair of the Tiger.*]

1. The hair of the tiger, opaque. 2. The wool of ditto, transparent.

The wool is beautifully fine; it is only the thousandth part of an inch in diameter. The serrations are likewise numerous, amounting to sixteen in each division, or 2560 in the space of an inch; they were small and somewhat confused; and, more to neutralize the felting principle, the number of curves are few.

The hair is covered with scales, resembling those on the back of a sole, and with no serration.

The fineness of the woolly fibre on these animals, compared with that which grows even on the Saxon sheep, is a circumstance deserving attention.

### THE DIFFERENCE BETWEEN HAIR, WOOL, AND FUR.

Now perhaps we should endeavour to set these points at rest, at least until further improvements in the microscope throw fresh light on the subject. Dr. Goring fancied he saw some toothed processes on the surface of the human hair. He has not figured this appearance; but the microscope, which developed the serrations of wool, has in some animals shown a similar appearance on the edge of the hair. On the hair of the seal and the tiger there are slight roughnesses, incrustations on the surface, but no serrated edge. The spiral projections on the surface of the bat's hair (fig. 1, p. 88), and the circular ones on that of the rabbit (fig. 3, p. 94), cannot be considered as serrations, and in the majority of the specimens of hair, the incrustations on the surface are too slight to give any decided serration to the edge.

The hair of the rabbit, the seal, and the tiger are illustrations of this; but, on the other hand, it will be seen that, in some neglected breeds of sheep, as the Wallachian and the Jamaica, there are decided, although slight, serrations.

The fibre of wool is crisped or curled, the curls increasing according to the fineness and felting property of the wool: hair is often disposed to curl, but in an inferior degree. The distinction, therefore, between these substances is more in degree than intent. *Wool is decidedly crisped and serrated; hair is sometimes curled, but to an inferior degree, and the irregularities of its edge, in some few cases, assume the form of slight serrations. Wool will felt; hair will only entangle and harle to a limited extent.*

This will, for every practical purpose, characterise these two substances, both of them referable to the influence of cultivation. The blood-horse has not a particle of wool about him—the neglected Shetlander is half covered with it. The fleece of the cultivated sheep has none of the hair that once deteriorated it, and is composed of wool. The uncultivated coat of all animals is composed of fur—*a mixture of wool and hair*—and either preponderating according to the localities and habits of the animals. The fur merchant, therefore, is right when, from the leopard to the sable, he applies the term fur to the covering which nature has given them: it is neither hair nor wool, but a mixture of both.

### THE DIVISIONS OF WOOL.

The old and apparently simple division of wool was into LONG and SHORT, or, according to the purposes to which it was devoted, COMBING and CLOTHING WOOL; but there was considerable difficulty in arranging some fleeces which were of intermediate lengths, and convertible to either purpose. The almost incredible improvement in machinery within the last few years, and the change which had long been gradually taking place in certain wools, unobserved even by the owners of the sheep, and stoutly denied by them when it was first exposed to public attention, and also the revolution that has since been effected in the character of other wools, and the purposes to which they are devoted, have rendered this division totally inapplicable.

In the classification of wools, at least of such as are of British growth and are consumed in British manufactures, the author adopts the arrangement proposed by an intelligent correspondent at Bradford, whose name he regrets that he is not permitted to divulge, viz., LONG, MIDDLE, and SHORT.

### LONG WOOL.

The most valuable of the long-woolled fleeces are of British origin. A

considerable quantity is produced in France and Belgium, but the manufacturers in those countries acknowledge the superiority of the British wool. It is to them what the foreign clothing wools have become to the English manufacturer. It is indispensable in many of their goods; and it is that by mixture with which, they are enabled to use the produce of their own country. In 1833, 1,424,208 lbs. of long wool were exported from England to France; and 3,275,448 lbs. to Belgium *. Long wool is distinguished, as its name would import, by the length of its staple. The average is about eight inches. It has much improved of late years both in England and in other countries. Its staple has, without detriment to its manufacturing qualities, become shorter; but it has also become finer, and truer, and sounder. The long-woolled sheep has been improved more than any other breed; and, since the close of Mr. Bakewell's valuable life, who may justly be considered as the father of the Leicesters, the principal error which he committed has been repaired, and the long wool has progressively risen in value, at least for combing purposes. Some of the breeds have staples of double the length that has been mentioned as the average one. Pasture and breeding are the principal agents here.

Probably, because the Leicester blood prevails in, or, at least, mingles with every other long-woolled breed, there has been rapidly increasing, a great similarity in the appearance and quality of this fleece in every district. The short-woolled fleeces are, to a very considerable degree, unlike in fineness, elasticity, and in felting property; the sheep themselves are still more unlike: but the long wools are losing their distinctive points—the Lincoln has not all of his former gaunt carcase, and coarse and entangled wool; the Romney Marsh has got rid of a little of the roughness of his form, and the length of his leg, while his wool, possibly a little thinner, has become truer and finer; the Teeswater has, in a manner, disappeared; the Cotswold and the Bampton have become varieties of the Leicester: in fact, all the long-woolled sheep, both in appearance and in fleece, are becoming of one family; and rarely, except from culpable neglect in the breeder, the fleece has not been injuriously weakened, or too much shortened, for the most valuable purposes to which it is devoted.

In addition to its length, this wool is characterized by its strength, its transparency, its comparative stoutness, and the little degree in which it possesses the felting quality.

Since the extension of the process of combing to wools of a shorter staple, the application of this wool to manufacturing purposes has undergone considerable change. In some respects the range of its use has been limited; but its demand has, on the whole, increased, and its value is more highly appreciated. There are certain and important branches of the woollen manufacture in which it can never be superseded, and connected with which it will be considered to be the staple produce of Great Britain.

> "If any wool, peculiar to our isle,
> Is given by nature, 'tis the comber's lock;
> The soft, the snow-white, and the long-grown flake †."

This long wool is classed under two divisions, distinguished both by the ength and the fineness of the fibre. The first, the long combing wool, is used for the manufacture of hard yarn, and the worsted goods for which that thread is adapted, and requires the staple to be long, firm, and little disposed to felt. The short combing wool, has, as its name implies, a shorter staple, and is finer, and more felty. The felt is also closer, and softer, and is chiefly used for hosiery goods. The middle wools are now

* MacCulloch's Dictionary of Commerce, Art. "Wool."
† Dyer's Fleece, book ii.

usurping the place of the short-combing ones, and the short-combing approaches nearer to the quality and purposes of the long-combing wool.

### MIDDLE WOOL.

The middle wool is almost a new article, but it is rapidly increasing in quantity and value. It will never supersede, but it will only stand next in estimation to the native British long fleece. It is yielded by the half-bred sheep, a race that will become more numerous every year, being a cross of the Leicester ram with the South-down, or the Norfolk, or some other short-woolled ewe; retaining the fattening property and the early maturity of the Leicester, or of both; and the wool deriving length and toughness of fibre from the one, and fineness and feltiness from the other.

Norfolk and Suffolk are taking the lead in the cultivation of this valuable breed; but the practice is establishing itself in every part of the kingdom, where the pasture and other circumstances will permit the introduction of such a breed. The average length of staple is about five inches. There is no description of the finer stuff-goods in which this wool is not most extensively and advantageously employed; and the noils (the portions which are broken off by, and left in the comb, whether belonging to this description of wool or to the long wool) are used in the manufacture of several species of cloth of no inferior quality or value.

Under the head of middle wools must now be placed those, that, when there were but two divisions, were known by the name of short wools; and, if we were treating of British productions alone, would still retain the same distinctive appellation. They are the South-down, Norfolk, Suffolk, Dorset, Ryland, and Cheviot wools; together with the fleece of several other breeds, not so numerous, nor occupying so great an extent of country. From the change, however, which has insensibly taken place in them all, —the lengthening, and the increased thickness of the fibre,—and more especially from the gradual introduction of other wools possessing delicacy of fibre, and pliability, and felting qualities, beyond what these could boast of, and, at the same time, being cheaper in the market than the old British wools ever were, or could be, these have gradually been losing ground in the manufacture of the finer cloths, and now cease to be used in the production of them. On the other hand, the change which has taken place in the construction of machinery has multiplied the purposes to which they may be devoted, and very considerably enhanced their value. It may be a little mortifying to the grower of the British short wool, to find that neither the superior, nor even the middle classes of society, will condescend to wear the cloths produced from his material; but human ingenuity has not only brought good out of evil, but has increased the advantages previously possessed, and has placed the interests of the grower and the manufacturer of wool on a basis which no changes in fashion or commerce can ever more materially affect.

A few years ago the grower of the British short-wools considered them as devoted to clothing purposes alone. He not only would have thought them disgraced, if the comb had been applied in the preparation of them for the loom; but, if pressed on that point, he would have confessed that they would not bear the action of the comb. Now they rank among the combing-wools: they are prepared as much, and in some places more, by the comb, than by the card. On this account they meet with a readier sale; and although, perhaps, they will never more obtain an extravagant price, yet, considering the increased weight of each individual fleece, and also the increased weight and earlier maturity of the carcase, they will, in proportion

to the value of other agricultural productions, and uninfluenced again by the changing character of the times, yield a fair remunerating price.

The qualities of these respective wools will be hereafter considered. The South-down sheep yield nearly seven-tenths of the pure short wool grown in the United Kingdom, the Dorsets, Rylands, Norfolks, &c., furnishing the remaining three-tenths: but these proportions vary in different districts, and, as has been already intimated, the half-bred sheep is, in some parts of the country rapidly, and in all of them gradually, encroaching on the pure short-woolled one—beautiful and valuable as the latter is.

The average staple of the British short-woolled, or rather, now, of this description of middle-woolled sheep, is 3½ inches.

Mr. Goodman, of Leeds, whose kindness the author particularly acknowledges, says, that "these wools are now employed in flannels, army and navy cloths, friezed coatings, Petershams, bear-skin and other coatings, heavy cloths for calico-printers and paper-manufacturers, woollen cords, coarse woollens, blankets, East India army cloths, and other woollen articles, many of them adapted to the trade of the United Kingdom, and largely exported to North and South America, the East and West Indies, Germany, and other places; besides, for the same purposes, being partially used in cassinets, baises, bockings, long ells, carpets, druggets, &c." Let the most enthusiastic admirer of the old short wools read this list, and say whether he has any reason to regret or to be ashamed of the change that has taken place.

### SHORT WOOL.

From this division every wool of British production, save the Anglo-merino, may be considered as now excluded. It consists chiefly of a rapidly increasing importation from our colonies of New Holland and Van Diemen's Land, a smaller quantity from Russia, a decreasing one from Spain, and an amount very great, but now seeming to be stationary, from Germany. A Table to explain these importations will be found in the next page.

These wools are employed unmixed in the manufacture of the finest cloths, and combined with a small proportion of British wool, in others of some inferior value. The properties of the two kinds of wool will be slightly noticed when the history and present state of the manufacture of wool in Great Britain come under notice. The average length of staple is about two and a half inches.

Even these wools may now be submitted to the action of the comb. There may be fibres only one inch in length, but if there are others from two and a half to three inches, so that the average of the staple shall be two inches, then a thread sufficiently tenacious may, from the improved state of machinery, be spun, and many delicate and beautiful fabrics, unknown a few years ago, readily woven.

### THE MANUFACTURING USES OF WOOL.

It is necessary to the completion of this chapter, that the principal uses of wool, long the most important manufacture of Great Britain, should be touched upon; and the more especially as an opportunity will thereby be afforded of briefly describing the respective processes of the woollen and worsted manufactures, and of pointing out more directly and clearly those peculiarities of conformation in wools of different breeds, which fit them for the one or the other purpose. The breeder cannot fail to derive some valuable hints from a careful consideration of the uses of wool; inasmuch

Account of Sheep and Lambs' Wool imported into Great Britain from Foreign Parts in the undermentioned Years, specifying the Countries whence it was brought, the Quantity brought from each, and the Rates of Duty, and the Produce of that Duty.

| Countries from which Imported. | 1810. | 1820. | 1825. | 1830. | 1832. | 1833. | Rates of Duty. | Chargeable. |
|---|---|---|---|---|---|---|---|---|
| | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | Until 5th July 1803. | Free. |
| Russia, Sweden, and Norway | 59,503 | 75,614 | 1,995,900 | 203,231 | 855,680 | 1,405,082 | From 5th July 1803, to June 1804. | 5s. 3d. per cwt. |
| Denmark | 351,741 | 13,527 | 554,213 | 179,717 | 302,848 | 372,490 | | |
| Prussia | 123,057 | 107,101 | 131,100 | 713,246 | 833,988 | 305,379 | — 1st June 1804, to 5th April 1805. | 5s. 10d. |
| Germany | 778,835 | 5,113,442 | 28,799,661 | 26,073,882 | 19,832,225 | 25,370,106 | | |
| The Netherlands | 2,873 | 186,051 | 1,059,243 | 939,123 | 209,144 | 811,031 | — 5th April 1805, to 10th May 1806. | 5s. 11d. 8-20ths |
| France | .. | 230,909 | 436,678 | 45,093 | 1,973 | 259,844 | | |
| Portugal | 3,018,961 | 95,187 | 953,793 | 461,942 | 193,544 | 681,968 | — 10th May 1806, to 5th July 1809. | 6s. 4d. 2-30ths |
| Spain and Canaries | 5,952,407 | 3,539,229 | 8,206,427 | 1,643,515 | } 2,626,624 | 3,339,150 | — 5th July 1809, to 15th April 1813. | 6s. 8d. per cwt |
| Gibraltar | 349,053 | 3,851 | 19,250 | .. | | | | |
| Italy | 21,554 | 2,815 | 227,453 | 9,461 | 78,552 | 855,510 | | |
| Malta | 40,040 | 5,050 | 72,131 | .. | 564 | 4,803 | — 15th April 1813, to 5th July 1819. | 7s. 11d. |
| Ionian Islands | .. | .. | 25,983 | .. | .. | .. | | |
| Turkey | .. | 189,584 | 513,414 | .. | 17,992 | 361,591 | — 5th July 1819, to Oct. 1819.. | 1d. per lb. |
| Morocco | .. | .. | .. | .. | 14,465 | 105,689 | | |
| Guernsey, Jersey, Alderney, & Man | 41,407 | 19,015 | 22,266 | 7,745 | 13,516 | 30,374 | | |
| East Indies | 701 | 8,056 | .. | .. | .. | .. | Of British Possessions. | Of Foreign Countries. |
| New Holland & Van Diemen's Land | 167 | 99,415 | 323,995 | 1,967,309 | 2,377,057 | 3,516,869 | | |
| Cape of Good Hope | 29,717 | 13,869 | 27,619 | 33,407 | 83,257 | 93,325 | From 10th Oct. 1819, to 5th Jan. 1823, 1d. per lb. | 6d. per lb. |
| British N.A. colonies, W.I., & U.S. of America | 4,111 | 1,477 | 80,538 | 9,038 | 628,915 | 335,649 | — 5th Jan. 1823, to 10th Sept. 1824, 3d. | 6d. .. |
| Mexico | .. | .. | .. | .. | 3,139 | .. | — 10th Sept. 1824, to 10th Dec. 1824, 1d. | 3d. .. |
| Peru | .. | .. | 14,313 | 5,741 | 23,191 | 14,640 | | |
| Chili | .. | 14,792 | 2 | .. | .. | .. | — 10th Dec. 1824, to 5th July 1825, 1d. | 1d. .. |
| Rio de la Plata and Brazil | 116,173 | 73,036 | 331,302 | 20,589 | 15,456 | 2,049 | | |
| Prize | 23,837 | .. | .. | .. | .. | .. | — 5th July 1825, free. | |
| Total Import from foreign parts | 10,914,137 | 9,789,020 | 43,795,281 | 32,319,059 | 28,142,489 | 38,076,413 | | ½d. per lb. on wool not of the value of 1s. per lb. |
| Quantities retained for Home Consumption | .. | 7,691,773 | 41,101,636 | 31,522,859 | 27,666,350 | 39,066,620 | | 1d. per lb. on wool of the value of 1s. per lb. and upwards. |
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | | |
| Amount of Duty received | 32,580 4 3 | 181,860 19 6 | 163,799 16 7½ | 120,420 8 0 | 102,031 2 3 | 137,855 1 8 | | |

[From MacCulloch's "Dictionary of Commerce."]

as a more definite and precise aim will be given to his attempts at alteration or improvement in any particular breed on which he may be experimenting.

For the sake of brevity, the two grand divisions of the woollen trade—the manufacture of cloth and the manufacture of stuffs—will alone be explained: the manufacture of hosiery goods being dismissed with this observation — that the wools best adapted to it should possess the properties which discriminate combing-wools, combined with softness. The shorter and finer combing-wools are, in fact, the best wools for the hosiery trade.

### THE MANUFACTURE OF CLOTH.

In this manufacture, the wool, being first dyed, (unless destined for black or such colours as either would not endure the after-process of milling and finishing, if dyed in the wool—in which case the cloth is made and partly finished ere it is dyed,) is subjected to the operation, of the scribbling and carding-machines. In order to understand these operations, the intention of which is to break down the fibres of the wool, to arrange them in an even mass or flake of a fibry texture, and to clear away all small particles of foreign matter, such as the substance of the dye-woods, &c., it is necessary to describe the machines.

### THE SCRIBBLER.

The scribbler consists of a number of large wooden cylinders, placed horizontally on a frame, and almost touching each other, with smaller cylinders placed above them, and also nearly touching. To these cylinders a rotatory motion is communicated by straps, which receive their impulse from the power—be it of steam or of water—by which the mill is wrought. The reader has now to imagine that these cylinders are covered with iron teeth, very minute and closely set, and slightly bent; and that these teeth, as the cylinders revolve in opposite directions and in very near contact, work against or within each other. It will be obvious that, if any substance of a fibrous nature like wool is placed between them, it will be torn, and separated into minute portions. Now this is just what is done by the scribbler. The wool is placed on a cloth (receiving its motion from the same source as the cylinders) which delivers it between two rollers, and then to the first large cylinder, the fine iron teeth of which catch it up as they rapidly pass the opening of the rollers.

By a peculiar and ingenious contrivance, the wool is transferred from one cylinder to another, until it is thrown off from the last in a flake of the most gauze-like texture—the wool adhering by means of its hooked or curved formation. In this state it is taken to the carder.

### THE CARDER.

This is a machine precisely similar to the scribbler in principle, but with numerous cylinders, and with wires or teeth of a finer texture. On this machine the business of breaking down the fibre, which varies greatly according to the fineness of the wool and the purpose for which it is destined, is still further carried on; but the wool, instead of being thrown off, as on the scribbler, in a thin flake, is formed into small rolls or cardings, as they are technically called, of about 30 inches in length. These are placed by young children on the Billy to be slubbed, the lengths being slightly joined by a dexterous movement of the hand.

To the slubbing, which is, in fact, a rough or preparatory spinning, suc-

ceeds the spinning—properly so called—and the thread is formed and ready for weaving.

### FULLING.

Let us imagine this process complete, and the cloth delivered by the weaver into the hands of the miller or fuller. It is first cleaned from the oil and other impurities attaching to it from the processes it has previously undergone; and then being placed in the fulling-stock, and liquid soap being thinly laid upon it, the process of felting, already described, commences, and is carried on until either the piece will felt no longer, or is as close and stout as the manufacturer requires.

### FINISHING.

When milled it is subjected to the action of the teazle, which draws the nap upon the surface; and that being cut down by the shears or knife, as close as the taste or the judgment of the finisher may think needful, form the short and silky pile, which is so much admired in woollen cloths.

It will be obvious, on a moment's consideration, that the closeness and richness of the pile or nap must depend on the fineness of the wool, and on the minuteness of the portions or fragments into which it will admit of being reduced on the carder and scribbler: the operation of the teazle being to draw out from the thread, and arrange in one direction on the surface, the ends of the broken fibres.

It will further be obvious, that in order to bear the action of the teazle without loosening the texture of the cloth too much, the wool should possess in a high degree the felting property; in other words, that it should possess numerous curves, causing the broken portions of the fibres to adhere by their mutual entanglement, and numerous and deep serrations on its surface,—the one multiplying the points of contact, and the other causing the adhesion of the fibres, when brought into contact, to be firm and tenacious. The degree, indeed, in which these two properties are possessed, discriminates the comparative value of clothing wools; other qualities, such as softness, fineness, &c., being equal.

On these properties the perfection of each process depends. The scribbling would dissipate the fibres, if they were deficient in the curved or hooked formation, and the thread could not be drawn out to a sufficient degree of fineness,—and if the serrations were few and superficial, the process of felting would leave the cloth loose in hand, and presenting on the surface, not that compact, close, and leathery appearance, which is so much sought after by the manufacturer, but a rough and shaggy nap, almost as opposite to the former as the rough pelt of the Shetland Galloway to the sleek skin of the race horse.

The process of the worsted manufacture shall now be described as briefly as possible, and some plain and palpable conclusions drawn from what has been stated.

### THE WORSTED MANUFACTURE.—COMBING.

The wool having been scoured and oiled, *the comb* is employed. It consists of a handle, with a transverse piece of wood attached to it, in the form of a rude **T** (⊤). Three rows of long sharp steel teeth are placed in the transverse piece. On these the wool is hung until the comb is filled or loaded; and the ends of the wool are either tied or hung over the transverse piece, in order to be securely attached to it. The workman, holding this comb on his knee, takes another that has been heated in a

comb-pot which stands by him containing ignited charcoal, and draws it through these locks of wool. It is the common combing of the head, and precisely for the same purpose, in order to separate and smooth the hair, and remove the portions that are entangled and knotted. It often requires the exertion of considerable strength to force the comb through the wool, and there would be hazard of breaking a great number of the fibres. In order to prevent this, the wool is previously oiled, to facilitate the passage of the comb, and the comb is heated that the oil may be perfectly fluid.

When the workman has succeeded in arranging the fibres in a direction parallel to each other, and made what is called a *sliver*, which is a long, loose, flowing stripe or lock of wool, it is transferred to the drawing and spinning frames, which, by their operation, elongate or draw out the sliver, (a rough thread, like the roll, or carding, described under the last head,) until the yarn is sufficiently fine for the intended purpose; and the web being woven, cleaned, and dyed, is ready for use, without any felting or raising of the pile or nap on the surface. These two processes, in fact, could not be carried on very easily, and in some goods, hardly at all, on account of the length, and the peculiar arrangement of the fibres in the thread of worsted yarn; and in which it differs entirely from woollen yarn; but the threads of both are brought to the requisite fineness by a force causing the fibres to slide over each other in the direction of the length of the thread, which, at the same time, is twisted so as to bind the fibres together.

This drawing out of the thread, which all, who have seen the common operation of spinning hempen bund, will easily understand, is regulated, in part, by the fineness of the wool, and, in part, by the purpose for which the yarn is intended. The ultimate limit to which the spinning can be carried, is, of course, determined by the former, as a certain number of fibres must cohere to give any tenacity to the thread *. Woollen and worsted yarns, however, differ, even when of equal fineness, in this important particular—the fibres in the former being placed in every possible direction, relatively to each other: those of the latter being all arranged in a parallel direction. It is evident that this formation of the latter originates with the combing, and is transmitted through all the subsequent stages of worsted spinning. The very different arrangement of the fibres in the woollen thread remains to be explained.

When the wool is wrought on the scribbler and carder, it is, of course, drawn very much in one direction of its fibres, but they are too short and minute for the finest cards to succeed in placing them in a strictly parallel direction; a fact quite evident from the circumstance of the wool adhering in a sort of light web, or loosely formed net-work, as it comes from the scribbler. On the carder, a certain portion of this filmy net-work is broken off by an ingenious contrivance, and rolled up into the carding on short threads. In this state the general direction of the fibres is across the thread, or in the line of its thickness. In the worsted thread, the

* The fineness to which the woollen thread has been spun almost exceeds belief. The following account is extracted from the Commercial and Agricultural Magazine for June, 1800.

A *hec* of woollen yarn measures in length 8 yards.

A *hank* of ditto, by the custom of Norwich, consists of seven hecs.

Twenty-four hecs in the pound, 13,440 yards, or about 7¾ miles, is esteemed good spinning in schools.

Seventy hanks in the pound, 39,200 yards, or about 22¼ miles, is esteemed superfine spinning at Norwich.

Three hundred hanks in the pound, 168,000 yards, or 95½ miles, have since been spun by Miss Ives, of Spalding, in Lincolnshire. This wool came from a sheep reared by Sir Joseph Banks. It was a cross breed by a Spanish ram out of one of the finest woolled Lincoln ewes.—Luccock on Wool, p. 154.

direction of the fibres is in the length of the thread, or just the very reverse of the former. In the process of spinning the latter, the points of the fibres are, in a great measure, covered; and the fibres themselves being long, and almost untouched, cause the thread to have a smooth, hard, and unbroken surface. The fibres, also, lying not merely parallel to each other, but in the same direction relatively to the position of the root and the point, there is no possibility, or a very slight one, of that hooking together,—that junction of the serrated edges,—on which, it has been shown, felting depends *.

Further, this formation of the fibre of worsted yarn opposes almost insurmountable obstacles to the action of the teazle, because the thread is compact; and if a nap is raised, the thread must be broken or torn up—a purpose for which it is obviously not formed.

Very different is the process of spinning woollen yarn. The fibres lying, as has been seen, across the thread, are, by the action of the spinning-frame, partially drawn into the direction of the length of the thread; and being very numerous from the breaking down of the carding-machine, present innumerable points on the surface of the thread,—the rudiments of the pile afterwards to be raised upon the cloth.

But this is not the only difference betwixt the two threads. The fibres of the woollen thread are commingled, so that the serrated edges come into contact,—it being obvious at once that, in the process of scribbling, the locks of wool are separated and broken up, and the individual fibres mixed and arranged in all possible directions. By this arrangement of the fibres in the thread of woollen yarn, two results are secured—the firm felting of the cloth, and the raising of a rich pile in the dressing of it.

The reader will now be prepared for another observation, viz., that the distinction betwixt woollen and worsted goods does not consist in any absolute difference or contrariety of nature in the wool of which the one or the other is made, but primarily in the mode of preparing the respective yarns; and secondarily, and consequent upon the peculiar formation of the thread, on the felting and raising of those fabrics only which are made of woollen yarn. True, worsted yarn must be made of wool of a certain staple or length; but, that difference apart, any wool may be made into woollen or worsted goods, indifferently, though the quality or excellence of the article will be greatly affected by the degree of suitableness or unsuitableness of the wools to the specific purpose to which they are applied. It needs no deep discrimination to discover the impropriety of breaking up on the scribbler, the long, rigid fibre of the Lincoln or Leicester wool for clothing purposes. It requires only a moment's glance at its formation

* Bakewell (of Wakefield) demonstrated the assertion here made—that the serrations must meet in order to the felting of wools, by a very simple and beautiful experiment. He took a lock of wool from the fleece, and tied it within a short distance of each end with silk, by which means the lock was divided into three portions; he then applied a minute quantity of soap, and worked the lock quickly betwixt his hands—in fact, he felted it by the compression of the hands—on precisely the same principle on which felting by the fulling or milling stock is effected. In a short time the two ends of the lock were formed each into a hard and solid button; the centre, betwixt the threads, was unfelted. He drew the conclusion, that wool will not felt unless the fibres are reversed relatively to each other, instead of lying, as on the sheep's back, in parallel lines—root to root, and point to point. The feathered or serrated edges could not meet or become entangled or locked together in the centre of the lock of wool, and therefore it did not felt—the ends being at liberty, the serrated edges met, and the felt was perfectly formed. Bakewell inferred the serrated or feathered formation from the experiment, and he reasoned rightly; we may now reason from the formation to the fact of felting, not more correctly, although a more strictly scientific, because more demonstrable, datum—Bakewell on Wool, p. 102.

(page 91) to perceive that it could not be formed into a thread at once soft, fine, and having numerous loose points or ends of fibres standing out on its surface: neither does it demand any great sagacity to discover the folly of diverting the close and deeply serrated fibre of Saxony wool to worsted stuffs, where any other wool of equal fineness, but deficient in the serrated edge, would be quite as valuable. The two fabrics, to be made in perfection, demand wools greatly differing in the degree of their curved and serrated formation; but the difference is one of degree only,—there is no opposition of structure, and each may be applied to either purpose, though with very opposite results,—in the comparative excellence of the manufactured article.

That the differences of adaptation to the one or the other great branch of the woollen trade was early discovered in wools of different families is perfectly evident from the fact of the very high antiquity of the comb*, and the more simple processes of felting, viz., by compression of the hands and of the feet. Hence a distinction originated of long and short,—or, combing and clothing wools; and hence, also, the confusion which must pervade any present arrangement of wools, whilst the very same kinds and qualities are used indiscriminately for both purposes. Hence, too, the necessity for that explanation of the different modes of spinning or forming the thread of woollen and worsted yarn respectively: upon which, in many fabrics, far more than on the peculiar length or formation of the fibre

* The invention of the comb and of the worsted manufactory is involved in great obscurity. From the simplicity of the preparation of the thread, it is not improbable that, although of somewhat later date than the art of felting, it was the first application of the loom to the manufacture of woollen goods. They who, in the time of the patriarchs, were skilled in the making of fine linen, would not fail of applying similar machinery to the conversion of the fibre of the fleece to kindred purposes. Ancient writers make no distinction between these essentially different preparations of different wools. Even when the spinning of worsted yarns, and the conversion of them into the peculiar kind of goods to which they were adapted, was established in the Netherlands, the writers of these days make no distinction between the different kinds of woollen articles. —*Luccock*, p. 63.

There is, however, no doubt that worsted goods were, like the other preparations of wool, first known in the East, and tradition has fixed on Armenia as the country whence they were transmitted to the regions of the West. Popular legends assign the invention of the comb to Bishop Blaise, who is said to have used it in Alderney. He lived, however, in Armenia, and suffered martyrdom under the tyrant Dioclesian. Dyer, in the second book of "The Fleece," has some pretty lines about him and his supposed discovery.

"Thus in elder time,
The rev'rend Blasius wore his leisure hours,
And slumbers broken oft; till fill'd at length
With inspiration, after various thought,
And trials manifold, his well-known voice
Gather'd the poor, and o'er Vulcanian stoves,
With tepid lees of oil and spiky comb,
Showed how the fleece might stretch to greater length,
And cast a glossier whiteness. Wheels went round;
Matrons and maids with songs relieved their toils;
And every loom received the softer yarn.
What poor, what widow, Blasius, did not bless
Thy teaching hand? thy bosom like the morn
Opening its wealth? What nation did not seek
Of thy new-modelled wool the curious webs?

What concern he really had in the improvement of the manufactory of wool it is impossible to say; but he was, like many of the Christian martyrs, cruelly tortured before he was put to death, and his flesh was torn from him with iron combs. The art of combing having been introduced into Europe by some merchants or travellers from Armenia, and every guild or fraternity of workmen having its tutelar saint, Bishop Blaise was selected as the patron of the wool-combers.—See *Luccock*, p. 38.

of the wool of which they are made, the distribution into the one or the other class of manufactures is founded. The merinos—a very beautiful fabric—manufactured of late years in enormous quantities at Bradford, are made of the best Saxon wool,—the very same as is extensively used in the neighbouring town of Leeds in the best woollen cloths: but in the manufacture of the former, the felting principle is not called into action; and is, indeed, partly forbidden by the arrangement of fibres, already described, as well as partially injured by the combing *; and in the latter, that principle is called into action, and expressly provided with the means of its fullest development, by the commingling and breaking of the fibres before the thread is formed.

It would, however, be erroneous to conclude that the distinction of combing and clothing wools is incorrect; on the contrary, wool which is soft, yielding, and, in proportion to its fineness, full of curves and deeply serrated, is adapted, by conformation, for the application of the fulling stock, and is misapplied when it is diverted to any other use. A wool, on the other hand, which is hard, unyielding, stout, or tenacious, and, in proportion to its fineness, deficient in curve and slightly serrated, is adapted to the comb, and can never be applied to the manufacture of cloth without serious disappointment. A clothing wool may be applied, with perfect propriety, to combing purposes, when of sufficient length and strength; but a combing wool is rarely, if ever, applied judiciously to clothing purposes.

The discovery of the serrated edge having now been happily made, an additional test of the fitness of wools for particular purposes is furnished to the manufacturer; whilst the breeder may learn to avoid a wrong or bad formation of the fibre, or to encourage a proper and good one. The former will either avoid mistakes in his appropriation of wool, or, better acquainted with the structure of the fibre, will discover new means of applying it to the fabrication of hitherto unknown articles of clothing. The latter will be able readily to discover the capabilities of particular breeds of sheep to produce wools of specific qualities of form and structure, and thus either reject or encourage, or modify, as prudence and judgment may suggest. Thus we may eventually arrive at a formation of the fibre of wool, in each of the two grand divisions of that valuable commodity, which shall combine all the qualities and excellencies demanded by the manufacturer,—each kind having all its own proper qualities, and being free from any one of those specifically belonging to, or only requisite in the other. The distinction, then, of clothing and combing wools will be accurate and scientific, because the appropriation of the wools will be restricted, necessarily and inevitably, to that branch of the manufacture, and to that only, under which they are respectively classed.

The change in the surface of the fibre, the obliteration of some of the serrations and the rounding of others, must necessarily lessen the felting property of the wool; the points of attachment will not be so numerous

* That the fibre of combed wools is partially injured in its felting property by that process is evident from the inspection of the cuts given in pp. 90 and 91. The serrated edge is partially destroyed. It is least apparent in the Saxon wool, p. 89; but in the South Down it cannot be mistaken when viewed either as a transparent or as an opaque object. In the transparent object the character of the serrations is altogether different; they scarcely project from many parts of the fibre, and some of them are nearly lost: in the opaque one the edges of the leaves that form the cups are smoothed or planed down. In the opaque fibre of the Leicester wool this is, if possible, yet clearer, and the sharp spines of the transparent fibre are changed into so many steps surrounding the column or pillar.

nor so firm, nor can the cloth be rendered so close and compact. The sliver, however, may on this account be better formed, the fibres may be brought closer to each other—they may assume more perfectly a parallel direction with each other—they may be more correctly arranged, and a finer, and at the same time a stronger yarn may be spun, and with less of that after-disposition to contract, which the manufacturer of worsted goods is so solicitous to prevent. The curves are diminished by nature in the wools devoted to the comb, and the comber diminishes and planes down the serrations; for, in the language of Luccock, "if these hairs contracted—and they are twisted in a spiral form, something like the threads of a compound screw—if these hairs contracted their length in any considerable degree, they could not be correctly arranged nor drawn out in that regular order which the work requires, but would be twisted into the thread in an irregular and crumbled form, a circumstance injurious to the yarn and to the goods which are made from it *."

Although the injury done to the felting property of wool, by the combing process, is undeniable, still it is not so material as to prevent even combed wool from being scribbled and felted. The noyles—those portions of combed wools which are retained in the comb, either because they are too short, or too much entangled, or too tender to pass into the sliver—are all used for the manufacture of cloth, and constitute a very important branch of the woolstapler's trade in all worsted districts. These wools felt well, but they have always what the clothiers call a wild or coarse *top*,—that is, they do not felt close on the surface of the cloth,—a circumstance which the character of the serrations and the injury done to them by combing readily accounts for.

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## Chapter IV.

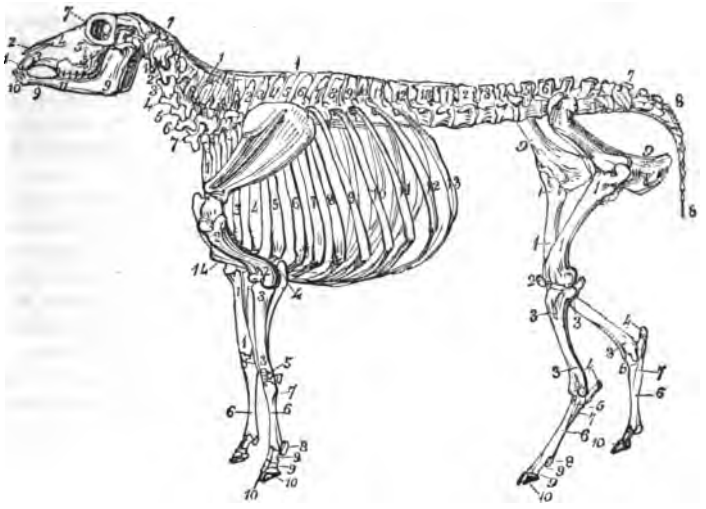
The History of the Foreign Breeds—Models—The Skeleton—The Leicester—South Down—Cheviot—The Fat-tailed Sheep—The African Sheep—The Egyptian—Ethiopian—Abyssinian—Madagascar—Cape—The Merinos at the Cape—The Angola Sheep—Guinea—Bearded—Barbary—Fezzan—Morocco—Tunis—The Tunis in America—The Asiatic Sheep—Persian—Thibet—East Indian—Ceylon—Javanese—Tartarian—The Argali—The Musmon—The American Sheep.

Before the history of the Sheep is commenced, and he is traced, so far as imperfect records will permit, through the different changes he seems to have undergone in different periods and countries, it will be advisable to give a sketch of him in his more perfect state, and as the gradual improvement of agriculture and of sheep-husbandry has made him. There would, however, be considerable difficulty attending this, if one kind of sheep alone was selected; for there is scarcely more difference between the hill and the vale country, than the practised eye perceives between the mountain and the lowland sheep. An outline of each of them must for the present suffice—the manner in which they have been bred up to their present state, and a

* One hundred and fifty hanks in the pound, 84,000 yards, or nearly 48 miles, were spun by Mary Pringle, of East Deriton, Norfolk; and this was thought so extraordinary that it was registered at the Royal Society.

lengthened account of the character and importance of the particular points of each, will be reserved for an after part of the work, when each breed will, in its turn, come under consideration. Enough will be given for the purpose of reference and comparison, as the early history of this animal proceeds.

The following skeleton is that of a Leicester sheep, but, perhaps, not of the best breed.



[*Skeleton of the Sheep.*]

*The Head.*

1. The inter-maxillary bone.
2. The nasal bones.
3. The upper jaw.
4. The union of the nasal and upper jaw bones.
5. The union of the malar and lachrymal bones.
6. The orbits of the eye.
7. The frontal bone.
9. The lower jaw.
10. The incisor teeth, or nippers.
11. The molars, or grinders.

*The Trunk.*

1. 1. The ligament of the neck, supporting the head.
1. 2. 3. 4. 5. 6. 7. The seven vertebræ, or bones of the neck.
1—13. The thirteen vertebræ, or bones of the back.
1—6. The six vertebræ of the loins.
7. The sacral bone.
8. The bones of the tail, varying in different breeds from 12 to 21.
9. The haunch and pelvis.
1—8. The eight true ribs with their cartilages.
9—13. The five false ribs, or those that are not attached to the breast-bone.
14. The breast-bone.

*The Fore Leg.*

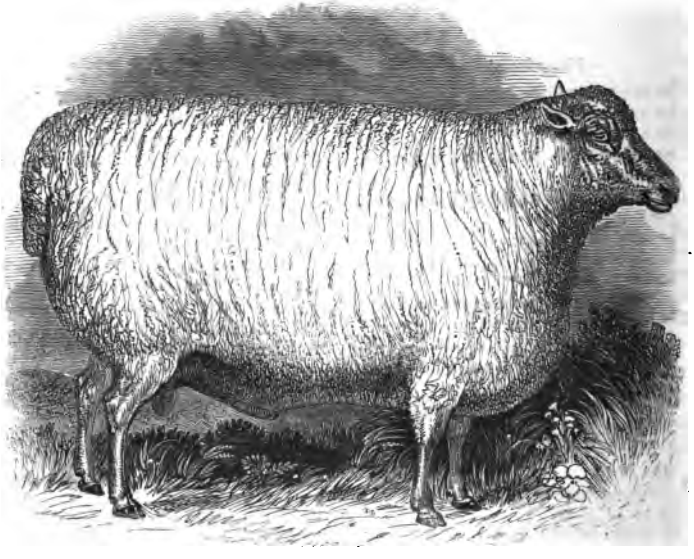
1. The scapula, or shoulder-blade.
2. The humerus, bone of the arm, or lower part of the shoulder.
3. The radius, or bone of the fore-arm.
4. The ulna, or elbow.
5. The knee with its different bones.
6. The metacarpal, or shank-bones—the larger bones of the leg.
7. A rudiment of the smaller metacarpal.
8. One of the sessamoid bones.
9. The two first bones of the foot—the pasterns.
10. The proper bones of the foot.

*The Hind Leg.*

1. The thigh-bone.
2. The stifle-joint and its bone—the patella.
3. The tibia, or bone of the upper part of the leg.
4. The point of the hock.
5. The other bones of the hock.
6. The metatarsal bone, or bone of the hind leg.
7. Rudiment of the small metatarsal.
8. A sessamoid bone.
9. The two first bones of the foot—the pasterns.
10. The proper bone of the foot.

As a lowland sheep, and destined to live on good pasture, the New Leicester is without a rival—in fact he has improved, if he has not given the principal value to, all the other long-woolled sheep.

The head should be hornless, long, small, tapering towards the muzzle, and projecting horizontally forwards. The eyes prominent, but with a quiet expression. The ears thin, rather long, and directed backwards. The neck full and broad at its base where it proceeds from the chest, but gradually tapering towards the head, and being particularly fine at the junction of the head and neck; the neck seeming to project straight from the chest, so that there is, with the slightest possible deviation, one continued horizontal line from the rump to the poll. The breast broad and full; the shoulders also broad and round, and no uneven or angular formation where the shoulders join either the neck or the back, particularly no rising of the withers, or hollow behind the situation of these bones. The arm fleshy through its whole extent, and even down to the knee. The bones of the legs small, standing wide apart, no looseness of skin about them, and comparatively bare of wool. The chest and barrel at once deep and round; the ribs forming a considerable arch from the spine, so as in some cases, and especially when the animal is in good condition, to make the apparent width of the chest even greater than the depth. The barrel ribbed well home, no irregularity of line on the back or the belly, but, on the sides, the carcass very gradually diminishing in width towards the rump. The quarters long and full, and, as with the fore-legs, the muscles extending down to the hock; the thighs also wide and full. The legs of a moderate length, the pelt also moderately thin, but soft and elastic, and covered with a good quantity of white wool, not so long as in some breeds, but considerably finer.



[*The New Leicester.*]

This account combines the main excellences both of Bakewell's own breed and Culley's variety or improvement of it. It is precisely the form for a

sheep provided with plenty of good food and without any great distance to travel or exertion to make in gathering it.

The principal recommendations of this breed are its beauty and its fulness of form, comprising, in the same apparent dimensions, greater weight than any other sheep; an early maturity, and a propensity to fatten equalled by no other breed; a diminution in the proportion of offal, and the return of most money for the quantity of food consumed *.

The sheep whose portrait is represented in the previous cut belonged to his Grace the Duke of Bedford.

The next is the hill sheep, adapted to more elevated situations and shorter feed on the natural and permanent pastures; able also to travel, without detriment, a considerable distance to the fold and to the down. There can be no hesitation in fixing on the South-Down as the model here.

The following is the substance of the description of this sheep by Mr. Ellman, who, if he may not be considered, like Mr. Bakewell with regard to the Leicesters, as founder of the breed, yet contributed more than any other man to its present improvement and value.

The head small and hornless; the face speckled or grey, and neither too long nor too short. The lips thin, and the space between the nose and the eyes narrow. The under jaw, or chap, fine and thin; the ears tolerably wide, and well covered with wool, and the forehead also, and the whole space between the ears well protected by it, as a defence against the fly.

The eye full and bright, but not prominent. The orbits of the eye—the eye-cap, or bone,—not too projecting, that it may not form a fatal obstacle in lambing.

The neck of a medium length, thin towards the head, but enlarging towards the shoulders where it should be broad and high, and straight in its whole course above and below. The breast should be wide, deep, and projecting forwards between the fore legs, indicating a good constitution, and a disposition to thrive. Corresponding with this, the shoulders should be on a level with the back, and not too wide above; they should bow outward from the top to the breast, indicating a springing rib beneath, and leaving room for it.

The ribs coming out horizontally from the spine, and extending far backward, and the last rib projecting more than the others; the back flat from the shoulders to the setting on of the tail; the loin broad and flat; the rump long and broad, and the tail set on high and nearly on a level with the spine. The hips wide; the space between them and the last rib on either side as narrow as possible, and the ribs, generally, presenting a circular form like a barrel.

The belly as straight as the back.

The legs neither too long nor too short. The fore-legs straight from the breast to the foot; not bending inward at the knee, and standing far apart both before and behind; the hocks having a direction rather outward, and the twist, or the meeting of the thighs behind, being particularly full; the bones fine, yet having no appearance of weakness, and of a speckled or dark colour.

The belly well defended with wool, and the wool coming down before and behind to the knee, and to the hock; the wool short, close, curled, and fine, and free from spiry projecting fibres.

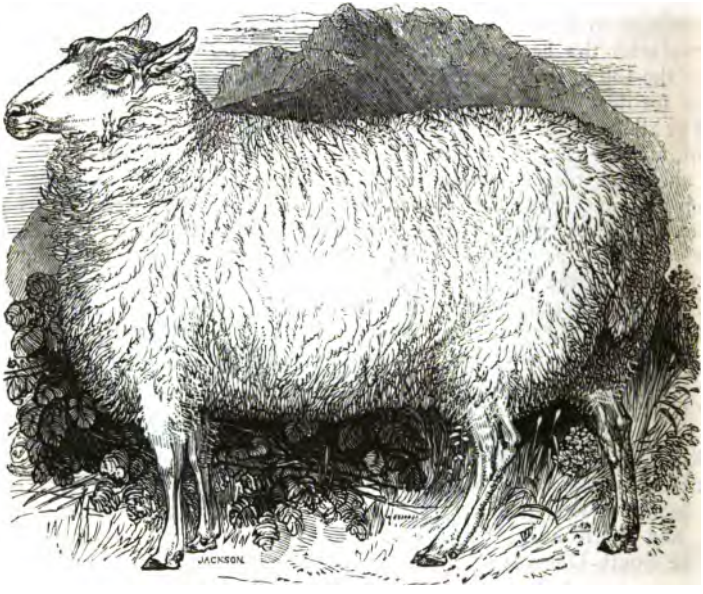
The South-Down is adapted to almost any situation in the midland part of England; it has a patience of occasional short keep, and an endurance of hard stocking, equal to any other sheep; an early maturity, scarcely

* Culley on Live Stock, and Marshall's Midland Counties.

[*The South-Down Ewe.*]

inferior to that of the Leicesters, and the flesh finely grained, and of peculiarly good flavour*.

The inhabitant of a still more elevated region and a colder clime, occa-




[*The Cheviot Sheep.*]

* Baxter's Agricultural Library, p. 453.

sionally exposed to the severest storms, yet enduring them and thriving, will complete the list of models; and among the British sheep, the Cheviot most deserves to be selected.

A description of them by a writer in the Farmer's Magazine, who had studied and known them well, is selected as a faithful representation of what they were, or what a good Cheviot should be, even before this breed had received the last improvement from the Leicesters:—

"The head polled, bare and clean, with jaw bone of a good length. Ears not too short. Countenance of not too dark a colour. (Repeated crossings with the Leicester have now made both the face and the legs white.) Neck full, round and not too long; well covered with wool, and without any beard or coarse wool beneath. Shoulders deep, full, and wide-set above. Chest full and open. Chine long, but not too long; straight, broad, and wide across the fillets. Hams round and plump. Body in general round and full, and not too deep or flat in the ribs or flanks. Legs clean, of a proportionable length, and well clad with wool to the knee-joints and hocks. Fleece fine, close, short, and thick set; of a medium length of pile, without hairs at the bottom, and not curled on the shoulders, and with as little coarse wool as possible on the hips, tail, and belly. A sheep possessing these properties in an eminent degree may be considered as the most perfect model of the Cheviot breed."*

These sheep, notwithstanding the strong prejudice that was entertained against them, have established themselves in every part of the South Highlands, almost to the exclusion of the native horned and *short* breed; and when their wool is become a little finer in the pile and somewhat shorter in the staple, in order to make it at the same time more portable by the animal and fitter for the cloth manufacturer; when the pelt is a little thicker, better to ensure, if need be, the hardihood of the breed, and the wool is a little more equal in point of quality on every part of the sheep, the Cheviot will extend itself also through the Northern Highlands, and there, too, the value of the sheep-farm and the comfort of the peasant will be more than doubled. The native black-faced breed—the *short* sheep—with which the Cheviot is still contending far in the north, and which he is gradually displacing, might, perhaps, deserve a place in the catalogue of models; but, valuable as he is, he must gradually give way, and in a manner disappear.

### THE FAT-TAILED SHEEP.

Several breeds of sheep, that seem to be derived from a variety of the primitive race, are found in the countries which the patriarchs traversed. In Syria, the chief residence of the early shepherds, a sheep is cultivated, of which Dr. Russell, in his History of Aleppo, gives the following account: "The dead weight of one of these sheep will amount to 50lbs. or 60lbs. of which the tail makes up 15lbs. or 16lbs.; but some of the largest that have been fattened with care weigh 150lbs., the tail alone composing one-third of the whole weight. This broad, flattish tail is mostly covered with long wool, and, becoming very small at the extremity, turns up. It is entirely composed of a substance between marrow and fat, serving very often in the kitchen instead of butter, and cut into small pieces, makes an ingredient in various dishes. When the animal is young, it is little inferior to marrow."

This race of sheep is found scattered over almost as large an extent of country as the fat rumps. They differ in the comparative accumulation of fat, compared with the general weight of the animal, and in the situation of the fat. In some, as in the sheep of Syria, it accumulates about the

* Farmer's Mag. 1810, p. 143.

upper part of the tail, and may very readily be considered as a variety of the *Steatopyga* already described. This strange collection of adipose matter has only shifted its situation a very little way, viz., from the posterior part of the haunch—the very rump—to the superior part of the tail. This variety might have been at first accidental, and perpetuated either by accident or design. Others have two large lobes of fat at the sides of the tail, reaching as low as the hocks. This is an extension of the first deviation. In a third variety, the masses of fat not only extend to, but chiefly occupy, the inferior part of the tail, which is naked and almost flesh-coloured. This further deviation presents nothing more remarkable than is found in other breeds. Sheep of one or the other of these varieties extend over Syria, Egypt, Southern Africa, Russia, India, and China *.

Dr. Russell thus continues his account of the Syrian sheep :—" Animals of this extraordinary size (150lbs.) are, however, very rare, and kept up in yards, so as to be in little danger of hurting their tails as they walk about: but in the fields, in order to prevent injury from the bushes, the shepherds in several places of Syria fix a thin piece of board to the under part, which is not, like the rest, covered with wool, and to this board are sometimes added small wheels ; whence, with a little exaggeration, we have the story of the oriental sheep being under the necessity of having carts to carry their tails. But the necessity of carriages for the tails of the African sheep, mentioned by Herodotus, Rudolphus, and others, is real. The tail of that animal when fat actually trails, not being tucked up like those of the Syrian sheep."

The following cut contains the delineation of a rather unusual variety of the fat-tailed sheep that formed part of the collection in the Jardin des Plantes in Paris. The profusion of long wool and hair, extending from the lower part of the neck to the brisket, gives it a singular, and not unpleasant, appearance.

[*The Fat-tailed Sheep.*]

The Animal Kingdom, vol. iv. p. 328.

Dr. Anderson, from Pallas, gives a more satisfactory account of the form and qualities of this sheep, as found among the Boucharian Tartars. He says that "it is seldom larger than the common Russian sheep: the head is like that of the fat-rumped, but the muzzle sharper, the body rather smaller than that of the fat-rumped; the ears large and pendent. They have a small collection of fat on the rump (a further corroboration of their being merely varieties of the steatopyga), a tail fat and broad at the base, with a long narrow appendage; and the wool compact and thick, soft and elastic, (so far, he of course means, as elasticity is compatible with softness—the elasticity of the fine-woolled Saxony fleece, each fibre of which, when cut into shreds, obstinately retains its native curls; accordingly he adds) regularly formed into frizzled circles *."

In the lamb (see p. 53) it appears like little delicate circular waves, which seem as if they were pressed close to the skin by art, and elegantly marbled, with feathered waves like silk damask.

Dr. Anderson well observes here that there cannot be a clearer proof of the pureness and trueness of the wool; for if any hairs mingle with it, they are always observed at the birth of the lamb: they are then more fully grown than the wool, and often give to the fleece an unsightly, shaggy appearance †. He adds, that a fleece of this character might be rendered exceedingly valuable under proper management; but that from a Tartar tribe it would be fruitless to look for improvement which must be purchased at the expense of patience and labour; and especially when, in their estimation, so ample a remuneration can be obtained by the slaughter of the lamb.

### THE EGYPTIAN, ETHIOPIAN, AND ABYSSINIAN SHEEP.

Travellers give a very unsatisfactory account of the sheep near the eastern coast of Africa, and on the borders of the Red Sea. The fat-tailed sheep prevail in Egypt, and both varieties of them are found; but those with long tails, nearly or quite reaching to the ground, are more numerous than the broad-tailed kind. They are of large size, mostly with black heads and necks, an external coat of hair, and their flesh well-flavoured ‡.

In Nether Ethiopia the sheep begin to be more numerous; they are large—some of them with tails from 18lbs. to 25lbs. in weight—with black heads and necks, and the remainder of their bodies white; others are quite white, with tails reaching nearly to the ground, and becoming curved at the extremity §. Here also the fat-rumped variety again begins to be found—smaller—more compact than those with long tails—with black heads and necks, and bearing resemblance to, but being of rather smaller size than the Persian sheep||.

Proceeding farther southward, they are, according to Bruce, taller and all black; their heads large, and with ears remarkably short and small. They

* Anderson on Sheep, p. 53.

† Speaking of the possibility of obtaining any of the Boucharian sheep for the purpose of experimental breeding, Dr. Anderson observes that it would be attended with almost insuperable difficulty. The southern provinces of Siberia, which border on the Kirguise country, where the best fat-rumped Russian sheep are found, are at least 2000 miles from Petersburgh, and the cattle which are sent from Siberia to the capital of Russia occupy about two years in completing their journey, passing through the hands of several different merchants by the way: it is therefore probable that a great proportion of them would die or be lost on the journey. Boucharia is at least 1000 miles beyond the Kirguise country, in the same route. The first destination of the Boucharian sheep and skins is the Siberian market; their after route is a hazardous speculation.—Anderson, p. 154.

‡ Anderson, p. 55.

§ Dapper's Africa, p. 86.

|| Ogilby's Africa, 1670. Pp 232 and 538.

also, like all the native sheep within the tropics, have an external covering of hair; but that hair is sometimes remarkable for its lustre and softness. The tail is neither large nor fat, and the mutton is remarkable for its pleasant flavour*. The smaller sheep, resembling, and, except in size, identical with, the Persian or primitive breed, is more prevalent. The cut given in p. 23, faithfully represents the usual Abyssinian sheep, but of a somewhat larger size. Here, too, pursuing this route through the African peninsula, we begin to find the many-horned sheep. When the usual number of horns is exceeded, most of the animals have four: travellers, however, mention one variety that has six—but the existence of these does not rest on unquestionable authority†.

There are few countries in which the rot is, at certain seasons of the year, more prevalent and destructive than on the banks of the Nile, from the Delta to Abyssinia, and yet there is no country in which it seems to be so much under control. As soon as the Nile returns to its bed, the Egyptians and the Bedouin Arabs drive their sheep to feed on the luxuriant pasturage which seems to spring up as it were by magic: but the soil is yet replete with moisture, and exposed, in Ethiopia and Abyssinia at least, to a tropical sun; and those deleterious miasmata are developed, which are now generally acknowledged to be the sole cause of the disease.

The sheep fatten on this new and succulent herbage with a rapidity almost incredible; but the poison soon begins to display its baneful influence. The Bedouins are watchful for the first indication of the rot, and they lose not a moment. They collect their flocks and drive them back to the deserts; and there, in the midst of the sands, and their principal food being of a dry and stimulating nature, the symptoms of the malady gradually disappear, and the sheep regain their former health. The Bedouins know not any other curative treatment—they want no other; or, if deluded by the rapidly increasing condition of the sheep, they loiter a little too long in the neighbourhood of the river, and this simple mode of treatment fails, they destroy the animal before he has wasted too much. When, however, the rot appears in that portion of the Nile, in Lower and in part of Upper Egypt, where despotism has established her throne, the inhabitants are indifferent to the progress of the pest. They know well the cause of it; but they attempt not to combat it. Their sheep and their wool belong not to them, and why should they occupy themselves with the amelioration of their flock, or endeavour to preserve them in health ‡?

At Cape Guarda, a little way south of the Straits of Babelmandel, the sheep are white, with rather small black heads. They are a large, handsome breed, resembling the Abyssinian and the Persian, except that they have broad, fat tails, six or eight inches in length §.

### THE MADAGASCAR SHEEP.

The eastern coast must now be pursued almost to the Cape of Good Hope before we can gather from travellers any authentic account of the character and value of the sheep. In the 13th degree of south latitude, however, the northern promontory of Madagascar presents itself, at no great distance from the African coast. The sheep resemble those on the opposite continent: they have large, broad tails‖, and nothing more would be said of them, had not Dr. Anderson ¶ given a long description of one of them,

* Bruce's Travels, vol. iv. p. 277.
† Dapper's Africa, p. 17.
‡ The Veterinarian, vol. iii. pp. 538, 590.
§ Anderson on Sheep, p. 59.
‖ Travels in Europe, Asia, and Africa, 1781. Vol. ii. p. 399.
¶ American Phil. Trans., vol. iv. p. 144.

and drawn some important, yet not altogether correct conclusions from his examination of the animal. He says, "A Danish East Indiaman put into Leith roads on her return home. I went on board to see what curiosities she had, and I there found a very fine sheep, which was closely covered with a close coat of thick, short hair, very smooth and sleek, like the coat of a well-dressed horse, but the hairs rather stiffer, and thicker set on the skin, and the colour a fine nut brown. This sheep, I was told, was brought from the island of Madagascar, and that all the sheep found on the island were of the same sort. Along with it was another sheep, brought from India, carrying a very close fleece of good wool, which," as he very properly remarks, and it is a principle that should never be forgotten by the sheep owner, "clearly proves the influence of breed in overruling that of climate."

Dr. Anderson had not examined the coat of this animal so closely as he might have done, and therefore, overlooking the wool (sometimes short, and small in quantity), which may always be found beneath its hairy coat, and which, at the period of moulting, is evidently separating from the pelt, and working its way through the hair, he draws the erroneous conclusion that "the sheep is not necessarily a wool-bearing animal, and that there are those that carry short, stiff hair only, and nothing that resembles wool, or that can be employed in manufactures for the same uses as wool; and others that carry long hair, that has been generally confounded with wool, and that may be shorn and employed in coarse fabrics in the place of wool." This cannot possibly be maintained. The sheep is essentially a wool-bearing animal. Nature has superadded another coat where the climate or other circumstances seemed to demand it; but man, by pursuing a judicious system of breeding, is able, in defiance of climate, not only to lessen, but completely to remove the hair.

### THE CAPE SHEEP.

The desert and almost unknown coasts of Adal and Ajan, and Maracatos, having been passed, the marshy district of Zanquebar, with its abundance of elephants, presents itself, with its city of Melinda, inhabited principally by Mahometans, but nominally dependent on the Portuguese. To this follows the Portuguese kingdom of Mozambique, and other various uncivilized tribes; and it is not until we reach the Dutch settlements north of the Cape that any authentic account of the sheep can be found.

The native Cape sheep are of the broad-tailed breed. Barrow gives one of the best descriptions of them *. He says that "they are long-legged, small in the body, and thin in the fore quarter and across the ribs. They have little internal or external fat, but it is all collected on the rump and on the tail †, proving them to be either a variety of the steatopyga, or a mixture of them and the broad-tailed sheep. The tail is short, broad, flat, naked on the under-side, and weighing from six to twelve pounds. The fat is of a semi-fluid nature, or rather having the consistence of a thick oil, and is frequently used as a substitute for it and for butter ‡."

* Barrow's Southern Africa, vol. i. p. 116.

† A writer of considerable talent, but evidently under the influence of much prejudice, says, that "they are wretched beasts; the other parts of the body seem drained to supply the accumulation of fat on the tail. They are lanky, sinewy beasts, more shaped for racing than roasting, and without an ounce of fat to encumber their speed."—Farmer's Magazine, Aug., 1821.

‡ From this description of Barrow, and whose fidelity cannot be doubted, it would not have been expected that the Cape sheep would have been very profitable feeders; yet another traveller writes, "It was not without much astonishment that we beheld the considerable number and unparalleled fatness of the sheep here, compared with the horrid drought and aridity of the land. In this part of the country they always look out for the

They are of every variety of colour—black, brown, bay, but mostly spotted; their necks are small, their ears long and pendulous; they weigh from 60 to 70 lbs. on their inland pasture, but when brought to the barren country about the Cape, they often dwindle down to 40. They are covered with strong frizzled hair, of which little use is made, except for cushions and mattresses. The sheep are neither washed nor shorn, but the wool is suffered to drop off of its own accord, which it does in September and October. The skins clothe the Hottentots and the children, or make bags for various household purposes."

These observations of Barrow refer to the native sheep alone, whether the property of the Hottentots, or of the European settlers, English or Dutch. Burchell gives a fuller history of the purposes to which the skin of the Cape sheep is devoted. "When these skins are properly dressed and cleaned, and a number of them sewed together, they form a much warmer covering than could be made from any other materials. The richer inhabitants, and those of Cape Town who can afford themselves more expensive coverings, affect to dislike the cheaper *koombaar* (the name given to these garments), because, they say, it smells of mutton; but the boor (the Cape farmer) is enabled, by his immense flocks, to select such only as have a smooth fur, and so he obtains a handsome coverlet, so unlike what a European could imagine for sheep's-skins, that it may be doubted whether many persons would even guess from what animal it was made. Those that have been brought to Europe have been viewed as the skins of some unknown quadruped. Few furs can be more beautiful than the selected skins of lambs thus prepared *."

When the Dutch began to settle in the neighbourhood of the Cape in 1650, the Caffers, notwithstanding their wild and savage life, were, to a considerable extent, shepherds. The country abounded with cattle, and more especially with sheep. The employment and the wealth of the boors, until they devoted themselves to the cultivation of the vine, consisted in the rearing and pasturage of oxen and sheep. Burchell sketches the following evening scene:—"It was an amusing and interesting sight to behold, a little before sunset, the numerous flocks streaming like an inundation over the ridges and low hills, or moving in a compact body like an army invading the country, and driven forwards only by two or three Hottentots, with a few dogs. At a great distance the confused sound of their bleating began to be heard; but as they approached nearer and nearer, the noise gradually increased till the various cries of the multitude mingled with the whole air, and deadened every other sound. The shepherds seldom returned home

leanest in the flock; the tail alone of one of these sheep (which is thick, and of a triangular shape, being from a foot to a foot and a half in length, and sometimes above five or six inches thick near the rump) will weigh from 8 to 12 pounds, and mostly consists of a delicate kind of fat, which is eaten with bread instead of butter, and is used for dressing victuals."—Sharrman's Voyage to the Cape of Good Hope, vol. i. p. 300.

It is to be hoped, for the sake of humanity, that the Hottentot method of butchering the sheep is not now in use. "They tie his fore-legs together and then the hind-legs, and then stretch him on his back, and rip up his belly, so that the entrails appear; then with one hand they gently tear them from the carcase, and with the other hand stir the blood that flows into the belly, in order to keep it from congealing. While the butcher is doing this, he avoids as much as possible the breaking of any of the large blood-vessels, by which means the animal is at least a quarter of an hour dying. Having torn away the intestines, another hastily cleans them, and lays a part of them on the fire to broil; and such dispatch is made, that this is generally devoured before the sheep is dead. The blood is then scooped out of the carcase with sea-shells, and put in pots, mixed with the remainder of the intestines, minced very small, and that forthwith is set a stewing. When the sheep is quite dead, he is skinned and eaten up."—Kolben's Cape of Good Hope, p. 226.

* Burchell's Travels in Africa, vol. ii. p. 175.

without bringing under their arms a lamb or two which had been dropped in the course of the day, and as yet too weak to follow their dam. The faculty which the Hottentots possess of distinguishing the features, as it were, and characteristic appearance of each sheep, is almost incredible, and they seldom mistake the ewe to which each lambkin belongs*."

Dreadful was the system of oppression pursued by the European invaders. The native inhabitants were all massacred or enslaved, or driven into the interior, whence they often returned to annoy and avenge themselves on their tyrants. It had been hoped that, when the colony at the Cape was permanently ceded to the British, the condition of the original possessors of the country, debased and strangely changed in form and in mind, would have been ameliorated; and so it doubtless would and will be, but the sense of oppression and injury rankled in the minds of the Bushmen, and, instigated by some runaway slaves, and infuriated by some, perhaps too severe, acts of legal justice, they have turned on their masters; and although the eventual security of the colony is not, perhaps, endangered, more than 80,000 head of cattle, and sheep almost innumerable, have lately (1834) been driven away or destroyed by the natives.

When the value of the Merino wool began to be acknowledged, a few of the Spanish sheep were sent to the Dutch colonies at the Cape of Good Hope; but the native sheep seemed, from the nature of its covering, to be so plainly adapted to the situation in which it was placed; and the prejudice was so strong, and so universal, that it would be useless to attempt to preserve the fineness of the Merino wool in the torrid clime of Southern Africa; and, perhaps the prevailing motive, the use of the fat obtained from the tail of the Cape sheep, was so various, and so identified with the likings and habits of the colonists, that few of the Dutch farmers could be induced to give the new-comers even the shadow of a trial. The experiments that were made were confined chiefly to the Government farms, and a few others in their immediate vicinity. It is needless to say that they were, to a great degree, unsuccessful.

When these colonies were ceded to Britain, a more extensive and a fairer trial was given to the Merino sheep at the Cape; and even then, though neither pains nor expense were spared, the success was at first far from being encouraging. Owing to bad management of various kinds, the wool actually seemed to have degenerated, and it was so much clogged with sand and small vegetable substances, as greatly to deteriorate its value in manufacture. A very intelligent traveller, and a colonist at the Cape, Mr. Thompson,

* Burchell's Travels, vol. i. p. 242. "I saw," says Sharrman, "an old Boshiesman and his wife, who, I was informed by a farmer, had, a few months before, reigned over a tribe of Boshiesmen. They were now translated from their former royal or patriarchal dignity to the station of shepherds over a few hundreds of sheep. On the whole, he gave them great commendation, as being exact in their business, and suiting their inclination to their fortunes, yet he indignantly reprobated that system of spoliation and oppression which could scatter a whole community, and degrade and enslave its sovereign." —Sharrman's Voyage, vol. i. p. 300.

Pringle had some such scene in his mind's eye, when he thus describes the Hottentot:

"Mild, melancholy, and sedate he stands,
Tending another's flocks upon the fields—
His father's once—where now the white man builds
His home, and issues forth his proud commands.
His dark eye flashes not;
——————he yields
Submissively his freedom and his lands.
Has he no courage? Once he had—but lo!
The felon's chain hath worn him to the bone.
No enterprise? Alas, the brand, the blow
Have humbled him to dust."—African Sketches.

confirms this statement. "This I am fully aware of, having sent home some wool esteemed of good quality, which lost above half its weight in washing, and produced a cloth about 12*s.* per yard in value, which I sold at the Cape, and the result paid me little more than 5 per cent. on the capital *."

The difficulties which at first opposed the establishment of the Merino sheep have now been conquered, and wool of excellent quality from almost every part of the colony, and particularly from the eastern districts, has been sent to England. Some British sheep have also been tried, particularly the South Downs; but there, as in their native clime, these have yielded to the Merino, so far as the manufacture of fine cloth was concerned. In 1804, there were in the colony 536,634 sheep. In 1811, there were 1,293,740, being an increase of 757,106 in seven years†. In 1810, 29,717 lbs. of wool were imported into Great Britain from the Cape of Good Hope. In 1833, the importation had increased to 93,325 lbs‡.

As to the actual state of the fleece, M. Lasteyrie, the unwearied advocate of the Merinos, uses this remarkable language, and which should never be forgotten by the breeder of every kind of sheep and everywhere :—'The preservation of the Merino race in its utmost purity at the Cape of Good Hope, in the marshes of Holland, and under the rigorous climate of Sweden, furnish an additional support of this, my unalterable principle, *fine-wooled sheep may be kept wherever industrious men and intelligent breeders exist* §.'

### ANGOLA SHEEP.

Skirting the south-western coast towards Guinea too little is known of the Africans, their habits, or their possessions, to justify any detailed account of their sheep. A very singular sheep, however, is found in Angola, called the *Zunu*. Its legs are long and slender, but the arms and shanks are muscular and strong. There is a slight elevation at the withers, the chest is narrow and flat, and falling in between the arms; the false ribs project, and give to the carcase a strong resemblance to that of the zebu. It is not the form which would promise much general thriftiness, and accordingly the fat is most singularly disposed. It is taken from the tail or rump, and is distributed over three parts of the animal. A small portion of it is spread over the posterior part of the loin and the commencement of the haunch. A more decided accumulation is found on the poll, and precisely of the semi-fluid character which the fat assumes in the tail, or the rump of other eastern sheep. This mass commences from the base of the ears, and extends backwards, in the form of a rounded projection, half way down the neck. Under the jaw, and commencing a little behind the angle of the mouth, and extending downwards and covering the superior part of the larynx, is a third collection of soft fatty matter, obtaining for the sheep, according to some naturalists, but improperly, for the tumour is too high and too forward, the name of the *goitred sheep*. This may be truly termed a curious variety of sheep; it is not found in any other part of the world.

The horns are very small, drooping at first, and then turning inwards and upwards; the tail, slender and almost naked, reaches very nearly to the ground. The whole animal is covered with short close hair, giving a very curious appearance to the tail. The neck and upper part of the carcase and tail are of a pale-brown colour; the head, throat, legs, belly, and the infe-

* Thompson's Travels in Southern Africa, 1827, vol. ii. p. 291.
† Burchell's Travels, p. 144.
‡ See Table, p. 101.
§ Lasteyrie on the Merino Sheep, p. 101.

rior part of the tail are white; the forehead is unusually prominent, the eyes small and sunken, the ears exceedingly large and pendulous *.

Other sheep, occupying the kingdom of Congo, are also covered with hair of a pale-brown colour, not close like the zunu, but loose and open, and with two wattles beneath the throat. The Coquo is also an inhabitant of Angola, having a greater proportion of wool under the hair, and of a finer quality, and white, with spots of a light-brown colour: the tail long and slender, but otherwise more resembling some of the European breeds. The long fat-tailed sheep, however, generally prevails. Anthony Hartwell, writing in 1597, thus describes them:—"Their muttons or sheepe are twice as grate as the sheepe of our countrey, for they divide them into five quarters (if a man may so call them), and reckon the tayle for one which commonly wayeth some twentie-five or thirtie pounds †."

### THE GUINEA SHEEP.

There are two kinds of sheep on the Slave coast. One is of a small size, and not unlike the prevailing European sheep, but of not more than half their size. "They have no wool, but," says the old Dutch traveller, Bosman, "the want is supplied with hair, so that here the world seems inverted, for the sheep are hairy and the men are woolly. The flesh is dry and unpalatable ‡." Barbot gives a similar account. "The sheep are not so large as ours, and have no wool, but hair like a goat, with a sort of mane like a lion on the neck, and so on the rump, and a bunch at the end of the tail. They are indifferent meat, but serve here for want of better §."

The most numerous breed of Guinea sheep is of a very different character. The male is horned, the horns generally forming a semicircle, with the points forward: the females are hornless. According to Major Hamilton Smith, there is usually some black distributed about the sides of the head and on the neck, and in proportion as this colour spreads, the horns decrease in size, the ears become pendulous, and *wattles* are found under the throat. He saw a large Guinea ram white, but with large black spots on the head, shoulders, flanks, and legs. On the neck there was a beautiful mane of long, silky white hairs ‖.

A modern traveller says that "the sheep in Guinea have so little resemblance to those in Europe that a stranger, unless he heard them bleat, could hardly tell what animals they were, being covered with white and brown hairs like a dog ¶."

In the early part of the seventeenth century the Guinea sheep were introduced into the islands near the Texel and into Groningen, and called the *Mouton Flandrin* or *Texel sheep*. Some strangely exaggerated accounts were given of them by the writers of the day. Corneille says in his Dictionary that "they produced lambs twice in the year, and usually three lambs at a time, sometimes four and five, and, occasionally, although rarely, seven at one yeaning." This is quite incredible, and Corneille himself acknowledges that it was only on their first arrival from the East, that they were thus prolific, but it will be shown, when the European sheep are described, that the Friezland and Texel breeds were, and still are, justly valued for their size, beauty of form, and abundant produce of long and fine wool, milk, and lambs.

* Animal Kingdom, vol. iv. p. 327.

† Akeport of the Kingdom of Congo, translated by An. Hartwell, from Odoardo Lopez, p. 202. ‡ Bosman's Description of the Gold Coast of Guinea.

§ Churchill's Collection, vol. v. p. 133. ‖ Animal Kingdom, p. 326.

¶ Smith's Voyage, p. 147.

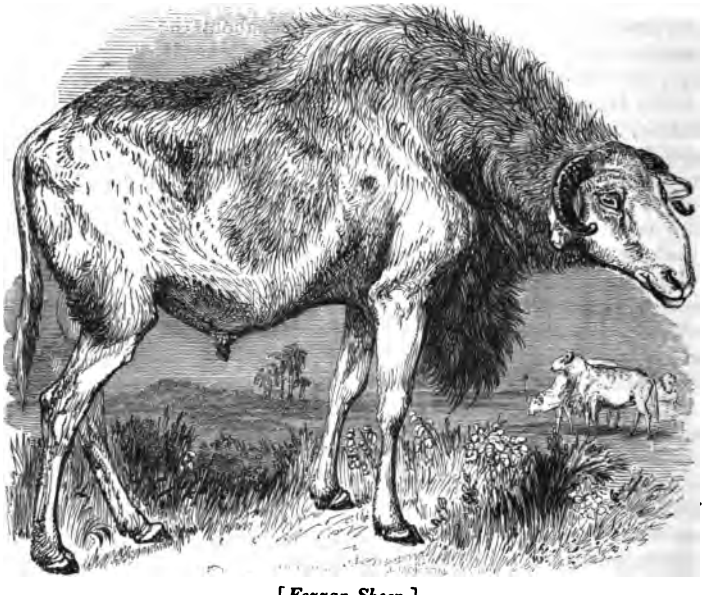
### THE BEARDED SHEEP.

This part of Africa presents an apparent exception to the generic character of the sheep. This animal was said (page 1) to have no beard, but a small variety of the Guinea sheep has a considerable quantity of long hair flowing down towards the brisket. It is not, however, a beard, a growth of hair from the face or the jaw, as in the goat, but proceeding from various parts of the neck, and sometimes as low as the middle of it, and therefore the character of the sheep being preserved. M. Geoffroy St. Hilaire, in his grand work on the Antiquities and Natural History of Egypt, describes it as not larger than a common sheep, and the throat furnished with long pendulous hairs. The horns are near to each other at the base, of a square form, turning inwards, and more than usually sharp. The knees are covered with long hair hanging all round them, with an appearance somewhat resembling ruffles, and hence it has been called the "*Ovis ornata*," or *Mouflon à manchettes*. It was shot in the neighbourhood of Cairo, but is said to be more common in Upper Egypt, and to be found in all the rocky portions of the deserts of Northern Africa *.

The "Bearded Sheep" of Pennant and Shaw, the "Ovis Tragelaphus" of Desmarest, is a different animal, and a goat rather than a sheep. It is sufficient to say that it is described as having hair on the superior parts of the cheeks and upper jaws extremely long, forming a divided or double beard †.

### BARBARY SHEEP.

Still pursuing the western coast of Africa in a northward direction, and traversing the kingdoms of Morocco and Fez, and then turning eastward



[*Fezzan Sheep.*]

* Dict. Classique d'Hist. Nat. tom. xi p. 264, and Wilson's Essays on the Origin and Natural History of Domestic Quadrupeds, in the Quarterly Journal of Agriculture, May, 1830.

† Pennant's Zoology, in loc.

within the Straits, and examining the productions of Algiers, and Tunis and Tripoli, the history of the sheep is indistinct and unsatisfactory. The long-legged, hairy sheep of Guinea is found in all these districts. It is largest and most numerous in the oases, or little islands of delightful verdure which are scattered over the ocean of sand that reaches from the western coast of Northern Africa to Egypt and Abyssinia. Fezzan is one of the largest of them, and has been most thoroughly explored. The preceding cut presents a portrait of one of them, in which the arched forehead, the pendulous ears, the shaggy hair, the dewlap beneath the throat, the disproportionate length of the legs, and the general characteristic gaunt and thriftless appearance of the animal, cannot fail of being recognised. This sheep belonged to the Zoological Society of London.

### MOROCCO SHEEP.

Major Hamilton Smith * says that the Morocco breed has long wool, the hair on the neck rather shorter and more undulating, and of a rufous brown; the ears small and horizontal; the horns small, but turning spirally outwards; the scrotum forming two separate sacs; the general colour white, with some marks of liver colour. A specimen sent by one of the princes of Morocco was in the possession of Sir Joseph Banks.

This is the first African sheep that in the least approaches to the expectations that are naturally raised respecting it by several undoubted historical facts. Columella, the uncle of him to whom we are indebted for a scientific and instructive work on agriculture (it is not a little disgraceful that it has never appeared in an English dress), lived near Cadiz during the reign of the Emperor Claudius. He happened to see some African rams, that were destined for exhibition, and probably cruel death, by wilder animals in the Roman Amphitheatre. He bought some of them, and he crossed his Spanish ewes with them; and his nephew tells us that the consequence was that he obtained a breed that resembled the sire in increased size and beauty of form, and the dam in the softness of the wool.

This is a proof, not to be disputed, of the value of the Barbary sheep at that time; and if it really possessed any good qualities, they would have been discovered and diligently cultivated, when some portion of the North of Africa had rivalled the metropolis and the mistress of the world in civilization and its attendant arts, and had not only been superior to her in extent of commerce, but had been the general emporium of the eastern and western worlds.

Of the high state of civilization to which the inhabitants of Northern Africa had risen, long before the importation of the first Barbary sheep into Spain, history contains sufficient proof; and even in the interior of Central Africa the traveller occasionally finds traces of ancient magnificence on which he gazes with wonder, but of the founders of which all memory has ceased. For many an age after the barbarians had swept away almost every vestige of civilization in the countries of Europe, literature and the arts, and doubtless the art of agriculture among the rest, found refuge among the dusky inhabitants of these regions; and the travellers who have lately penetrated deeply into Central and Southern Africa have given accounts altogether unexpected, and, therefore, for a while disbelieved, of many a district rich in all the productions of nature, and the resources of art.

More than thirteen hundred years after the time of Columella, Pedro IV. of Spain, whether judiciously or otherwise does not clearly appear, imported several Barbary rams for the supposed improvement of the Spanish sheep; and two hundred years subsequently, the Cardinal Ximenes had recourse to

* Animal Kingdom, vol. iv. p. 326.

the African rams for the same purpose. The whole of the northern coast of Africa has, however, been now explored, and with the exception of the *Morocco breed*, described by Major Smith, scarcely a native African sheep has been met with that deserves cultivation.

What is the evident conclusion from this, but that the sheep is the child of cultivation? It may be bred and managed so as to become almost all that the agriculturist and the manufacturer could wish it to be; and if habitually neglected and abused, every good quality will gradually disappear.

In this *Morocco breed*, however, with its long wool and prevalent white colour, some capability of former or of future improvement may be easily imagined; and the ingenious naturalist to whom reference has just been made gives a description of another variety of African sheep, more plainly developing the inherent tendency to improvement. "The last African race," says he, "we shall notice, is found in Barbary, and even in Corsica. It is policerate (more than two horns), with pendulous ears, and the tail not much widened; white in colour, posterior parts covered with wool; and from the head to the shoulders, with loose, soft hair. A crossed breed of this race with the Guinea sheep, and brought from that country, was in the possession of R. Wilding, Esq. It was entirely covered with soft, silky hair, of a silvery whiteness; on the fore and hind part of the neck the hair was of great length, especially in front; half of the nose was jetty black; on each knee and each thigh a black spot; the fetlocks and feet white. In the month of November, it began to assume a soft, woolly coat, like that of the English sheep*."

### THE TUNIS SHEEP IN AMERICA.

A still more satisfactory account of the capability of the Barbary sheep is given by Mr. Peters, of Lancaster county, in the United States. It is extracted from the Philosophical Society of Philadelphia, of which he was President. He imported some sheep from the neighbourhood of Tunis. They were hornless, and their bones small. A ewe that was killed fat, weighed 182 lbs. The fat was laid on the profitable points; it was mingled with the flesh, which was marbled in a striking degree. The mutton was acknowledged to be among the finest and best in the market; and the proportion of flesh to the size of the animal was remarkably great. The tail weighed from six to eight pounds, and, says Mr. Peters, "if properly dressed, is a feast for an epicure. The tail of a young beaver, which I have enjoyed when I dared to indulge in such food (when free from a fishy or sedgy taint, to which at certain seasons the flesh of amphibious animals is subject), is the only rival I know."

The sheep were hardy, would bear cold and heat well, would fatten with little food, and much quicker than most other breeds. They were kept in condition on coarse food, and their character was that of gentleness and quietude. The lambs were dropped white, red, tawny, bluish, or black,—but the fewest of the latter. All, except the black, grew white in the colour of their fleece, although some few spots were generally left. The cheeks and shanks, and sometimes the whole head and face, were either tawny or black.

Of the fleece, he says that these sheep were better set with wool than any others that he knew in America,—the weight from 5 lbs. to 5½ lbs. and useful for a variety of purposes. He never saw better home-made cloth than the selected parts of the Tunis fleeces, and especially the cut next the pelt afforded; and, alluding to their peculiar management, or

* Animal Kingdom, vol. iv. p. 329.

sorting of the fleece, he says,—" some of them will bear three cuts of an inch and a-half, or two inches long, fine. Many of the fleeces are of this description, and more are short and fine. Of worsted and fleecy-hosiery, I have not seen any wool producing superior fabrics for common use. I have seen some fleeces apparently furry next the pelt, like the beaver, but consisting of very fine-fibred wool."

Almost the only African woollen manufacture, that can be considered as an article of commerce, is found at Tunis; and a very curious one it is. It is the skull-cap so common in the Levant, and which is worn by every Greek, and almost by every Barbary sailor, and by all the artisans and lower classes on shore. Mussulmen, Jews, and Christians, all shave their heads and wear the oriental dress in the Levant, and on the Barbary shore. Before these caps were imitated at Leghorn and Marseilles, more than 50,000 persons were employed in the regency of Tunis in the manufacture of them. Those made in Africa are, however, still most valued for their brilliancy of colour, their fineness and durability*.

### THE FAT-TAILED SHEEP IN ENGLAND.

With a quotation from Ellis, describing the African fat-tailed sheep in England, the account of that breed shall conclude:—" The Turkey-sheep is of the large, heavy sort, and the more so because their broad tails are of a considerable weight. It is reported that one of their tails has weighed 14½ lbs., and that the whole sheep was sold for 60*s*. I have heard of a gentleman that lives within twenty miles of London, who keeps about thirty Turkish ewes and a Turkish ram;—that the ewes are all polled, and the ram a horned sheep,—that all of them have broad tails, with white fleeces, speckled with black spots, and mottled like a leopard,

* An account of the apparently rude manufacture of these caps in Tunis may not be uninteresting to some of the readers of this treatise. The wool (the proportions of native Tunisian and of Spanish wool varying according to the intended fineness and price of the article) is combed and spun into a fine soft thread, and woven, or oftener knit, into caps of a conical form like a night-cap. These are soaked in oil, and then, a kind of form being placed on the knee of the workman, they are milled by rubbing the sides together, frequently turning the caps. By this process they are reduced to about one-half of their original size. When the cap is sufficiently thickened, it is brushed with a *bur* from a kind of thistle, in order to bring out the nap; the fibres which project too far, being cut off with a pair of shears. The caps thus reduced, napped, and clipped, are in the form of a semi-globe. In this state they are sent to Zawan, about thirty miles from Tunis, in order to be dyed of a deep crimson colour. The water at this place is supposed to possess the quality of giving a peculiar richness and permanence to the dye. Being now returned to the manufacturer, they undergo a second milling, are clipped, and dressed with the greatest care, until the surface has the appearance of the richest velvet. A neat tassel of mazarine blue silk thread is then sewed to the top, and the cap is considered to be finished.—Mac Gill's Account of Tunis, p. 152.

The same writer gives a curious account of the trickery of the African wool-growers and dealers. " The wool of the different parts of the regency is of various kinds and qualities; but the greatest difference results from the quantity of dust and sand that are mixed with it, in order to increase its weight, and each district having its own peculiar method of thus adulterating it. The shepherds in one part of the country, a little before sheep-shearing, hunt their flocks upon the sands until they are in a high state of perspiration; when the sand, flying in clouds, mixes with the wool, and adheres to it. This is repeated for several days, until, sometimes, a greater weight of sand is driven into the fleece than the real weight of clean wool, and the loss on washing is consequently very great. In some places the loss is from 50 to 55 per cent. In the immediate neighbourhood of Tunis it is 40 per cent.

The time for buying wool is the month of June, when the Arabs bring it to market. The price is somewhat higher if it is bought of them in the small quantities that each brings, than if it were purchased wholesale from the merchant; but the first is the best and the cheapest method, for the merchants not only take out the wool of finer quality, but mix mire, and sand, and filth with the residue, in order to increase its weight.—Ditto, p. 146.

but their wool is long, and of a very coarse nature. Another gentleman in Hertfordshire kept three or four of these Turkey-sheep; one of their tails weighed 8 lbs.; and one of their lambs at shearing-time weighed 16 stones alive*."

### THE ASIATIC SHEEP.

Returning to Asia,—the character of the sheep, in early times, in Palestine and Syria, and that part of the Eastern country over which the primitive shepherds wandered, has been already sufficiently described; and it remains only to say, that although three thousand years have since elapsed, they have not materially changed. A few of the fat-rumped, but more of the broad-tailed, variety are seen. In the latter, the carcase is in a great degree neglected: the hairy or woolly covering of the animal being coarse, is comparatively valueless; while the fatty portion of the tail is increased to one-fourth, and sometimes to one-third, of the weight of the whole animal.

In *Stony Arabia*, and the still more southern part of Arabia, the fat-rumped species is almost exclusively found; and the wool was once highly prized, and is still valuable.

### THE PERSIAN SHEEP.

In *Persia*, more of the fat-tailed sheep are found than of the fat-rumped already described (p. 23); but although they constitute one of the chief sources of the wealth and property of a large class of the inhabitants, no care is bestowed on their improvement. The shepherds still follow the wandering life of their ancestors three thousand years ago. Fraser gives a singular account of the march of one of the tribes. It will be interesting to compare it with the peregrinations of the primitive keepers of sheep already described.

"When the pastures are bare, they shift to some other spot. The march of one of these parties is a striking spectacle. The main body is generally preceded by an advanced guard of stout young men, well armed, as if to clear the way; then follow large flocks of all kinds of domestic animals, covering the country far and wide, and driven by the lads of the community. The asses, which are numerous, and the rough, stout yaboos (small horses), are loaded with goods, tents, clothes, pots and boilers, and every sort of utensil, bound confusedly together. On the top of some of the burdens may be seen mounted the elder children, who act the part of drivers; and on others the lesser urchins not able to speak, yet quite at their ease, neither seeking nor receiving attention, but holding on manfully with feet and hands. A third class of animals bear the superannuated of the tribe, bent double with age, and hardly distinguishable from the mass of rags that forms their seat. The young men and women bustle about, preventing, with the assistance of their huge dogs, the cattle from straying too far. The mothers, carrying the younger infants, patiently trudge on foot watching the progress of their domestic equipage. The men with sober, thoughtful demeanour, armed to the teeth, walk steadily on the flanks and rear of the grotesque column, guarding and controlling its slow and regular movement†."

Much wool is grown in those districts of Persia, where the majority of the inhabitants lead a pastoral life; the best is found in the province of Kerman. This is a very mountainous country, hot and dry in summer, and intensely cold in winter. The wool of the sheep is fine in quality, and that which grows at the roots of the hair of the goat is nearly as fine,

* Ellis on Sheep, p. 49. † Fraser's Persia, p. 370.

The latter is spun into various fabrics, which almost vie with the beautiful shawls of Cashmere. The *numuds*, or fine felt carpets, for which Persia is so celebrated, are manufactured from the wool of the sheep, either in Kerman or Khorasan*. These districts are far distant from each other, but the sheep in both of them "is remarkable for the fine spirally-curled wool, of a grey, or mixed black and white colour, which is obtained from it. The sheep are below the ordinary size, the horns of the ram curved back and spiral at the tip, the ears pendulous, the colour dirty white with a fine grey wool beneath, and the tail not very broad. The fine furs are from the lambs slaughtered with their dams a few days before yeaning †."

At Kabooshan, in the mountains north of Khorasan, is a celebrated manufactory of sheep-skin pelisses, called *posteens*. The skins, having been dressed with the wool on, are cut into narrow stripes; the coarser and inferior portions are rejected, and the others sewed together with the wool outside, and made into pelisses, which are almost universally worn in the winter. The best are formed from the skins of unweaned lambs, and are exceedingly fine and light: the price of these is often enormous. The next in value are from the skins of selected sheep, not more than a year old; the coarser skins are used for the poorer people ‡.

The singular difference in the colour and brilliancy of the fleece of the Persian sheep contributes to give greater variety and value to these garments. In some breeds of sheep, the hair is only sufficiently long to admit of one curve, which lies close on the skin, and has a pleasing appearance; in others the fibre, although three inches long, is scarcely curved, except at the extremity; and some have long, grey, shining wool, falling in numberless ringlets, and appearing behind like strings of pearls §.

Wild sheep frequent many of the mountains of Persia, and especially those in the neighbourhood of Nishapoore. Fraser thus describes one of them:—"While I was in the village a ram of this description was killed by one of their hunters, and brought to me as a present. It was a noble animal, just what it might be conceived the finest sort of domestic ram would be in a state of nature; bold, portly, and very strong; thick like a lion about the neck and shoulders, and small in the loins; covered with short reddish hair that curled closely about the neck and fore-quarters, and bearing an immense pair of crooked and twisted horns. Its flesh, of which we ate a part, was remarkably well-flavoured ‖."

### TIBET SHEEP.

The sheep of Tibet are numerous. They are chiefly a small variety of the fat-rumped Persian and Abyssinian, with black heads and legs. Some of them have a small portion of wool at the root of short hair, but in other breeds the wool is long, soft, and fine. Many of the costly Indian shawls are made of the long wool. The skins of the others are usually prepared with the wool on them, and form, like the skins of the Persian sheep, very comfortable winter clothing. The inhabitants of Tibet are too indolent to take any advantage of the excellent materials which their country produces, and a considerable proportion of their wool is sent into Persia and British India to be manufactured.

The flesh of the Tibet sheep is said to be peculiarly well-flavoured, but

* Fraser's Travels on the banks of the Caspian, p. 359.
† Animal Kingdom, vol. iv., p. 329.
‡ Fraser's Journey through Khorasan, p. 573.
§ Ogilby's Asia, p. 38.
‖ Fraser's Journey through Khorasan, p. 421.

the inhabitants mostly eat it dried and raw; it is said, however, that when cured in the frosty air, it is not disagreeable to the most fastidious European palate.

The Tibet sheep are occasionally employed as beasts of burden. Captain Turner says, that he has seen whole flocks of them in motion, laden with salt and grain, each carrying from 12 to 20 lbs*.

### EAST INDIA SHEEP.

Descending from Tibet towards the south, the British East Indian possessions occur. The history of the native and imported sheep in that extensive country is very defective. All that can be certainly gathered is, that in many of the northern districts the animal is small, and the fleece consists of coarse and frequently black wool and hair, altogether unsuitable for clothing purposes. Small rugs or coverlets are made from it, principally used by the shepherds and the most inferior castes. The greater part of them are of the fat-rumped and fat-tailed breeds, and the first more especially prevail in the upper districts. Mr. Hodgson, however, describing the northern division of Nepâl, (Nepaul,) and giving a long account of a variety of the Musmon, and to which allusion will again be made, when the Argali and Musmon are described, says, that "the wool of the Huniah or Bhotean domesticated sheep is superb, but it is suited only to the northern region of Nepal, suffering much from the heat of the central district." He suggests that attempts should be made to naturalize this breed in England †. Many sheep are found with considerable resemblance, in form if not in fleece, to the Persian in the peninsula, and particularly in the Mysore country. They are without horns; they have small and drooping ears, and the wool fine, with numerous curves, and adapted to many clothing purposes. Sir Joseph Banks had a specimen which belonged to the park of Tippoo Sultan at Seringapatam ‡.

Colonel Sykes thus describes the variety of sheep most extensively bred in Dukhun (the Deccan). It has short legs, short thickish body, and arched forehead. The wool is short, crisp, and harsh, and is almost universally black. In most individuals there is a white streak or line from the anterior angle of each eye towards the mouth, and a white patch on the crown of the head §.

This sheep is smaller than any of our English breed, and often not weighing more than eight or ten pounds a quarter. The mutton is exceedingly good. By the kindness of Colonel Sykes the author was enabled to examine a small portion of the wool. The following is a delineation of it as developed by the microscope.

[*Wool of the Deccan Black Sheep.*]

1. The wool seen as a transparent object; the serrations very indistinct and small, as if the cups scarcely projected. There were only eight serrations in the field of view, and consequently only 1280 in the space of an

* See Captain Turner's Account of an Embassy to Tibet, p. 302, &c., and Pinkerton's Geography, article Tibet.

† Proceedings of the Zoological Society of London. 1834. Part II. 99.

‡ Animal Kingdom, vol. iv., p. 330.

§ Proceedings of the Zoological Society, 1830-31. Part I. p. 105.

inch. The curves were also very few. The fibre, however, was not more than $\frac{1}{1000}$th part of an inch in diameter.

2. The wool seen as an opaque object. On account of its black colour it was very difficult to bring out its true structure; nevertheless a few of the leaves constituting the cups may be seen bearing a near resemblance in shape to the bay-leaf. They are very irregularly scattered. It will be evident, that on account of the fewness of the curves, and also the paucity and shallowness of the serrations, this wool can never be valuable as a clothing wool; it is only used in the manufacture of blankets, carpets, and coarse goods of this description.

### THE CEYLON SHEEP.

At the point of the peninsula is the island of Ceylon. Very contradictory accounts have been given of the breeding and keeping of sheep in this island. Some have asserted that it is almost impossible long to preserve a flock of sheep in Ceylon; and, in fact, it is only at Jafnapatam that they have ever been bred or pastured with success. The difficulty, however, does not seem to consist in any deficiency of pasture, or any noxious quality that it generally possesses, or any deleterious atmospheric influence prevalent in the island; but Ceylon abounds with bears, jackals, alligators, and enormous serpents, by whom so many sheep are occasionally destroyed, that the sheep-owner abandons the cultivation of that animal in despair. Some particular spots, nevertheless, are said to abound with poisonous plants, and whole flocks of sheep straying there have been lost *.

### THE JAVANESE SHEEP.

Of these there are two varieties. They are both of a moderate size, but some have a pendulous growth beneath the jaw; the coat consisting principally of hair; the tail unusually large and fat, and weighing occasionally forty or fifty pounds: they are short-legged, and of a red and white colour. The other variety is white, with exceedingly long and pendulous ears; it yields much milk, so as to be useful for the purposes of the dairy, and is clothed with prettily curled wool †.

The other islands in the Indian and Pacific Oceans, containing principally, and some of them exclusively, the Spanish sheep, will be passed over until the peregrinations of that excellent breed are traced.

Of the Island of Japan, situated more northerly on the western coast of Asia, Thunberg (strangely, and probably truly) says that there are no sheep to be found in the whole of it ‡. There is scarcely another part of the globe, of any considerable size, of which this could be affirmed.

### CHINESE SHEEP.

Returning now through the interior of Asia, the immense empire of China first presents itself; and, as might be naturally expected in such an extent of country, breeds of sheep, differing much from each other, are found. First is the LONG-LEGGED SHEEP, resembling the African Adimain breed. They are not quite so high on their legs as the African sheep; the horns are middle-sized, and curved; the forehead is arched; the neck short, with a collar of hair reaching from the nape of it to the shoulders; the head, the legs, and the mane are of a red brown colour; the tail is long, and the wool short and coarse §.

* Agricultural Magazine, November, 1805.
† Niehoff's Travels (Churchill's Collection), vol. ii. p. 320.
‡ Thunberg's Travels, vol. iv. p. 95.
§ Animal Kingdom, vol. iv. p. 330.

More to the south the fat-rumped sheep prevail, yielding every variety of wool; and in the same districts are found a smaller, lower sheep, of a more European character, and producing a fine and very useful long wool. The Chinese manufacture some good serges from it, not so close as those made in Europe, but thinner and finer, and having a peculiar silky appearance. They likewise prepare a considerable quantity of felts of various colours. The largeness and beauty of the Chinese carpets have often been praised. An old traveller says, that "when the Dutch presented the Emperor of China with some scarlet and other cloths made in Europe, he asked how, and what they were made of? Being told, he replied that his subjects could make them, and, therefore, there was no need to bring them so far *."

### TARTARIAN SHEEP.

The wilds of Central Asiatic Tartary present nearly the same breeds of sheep, and the same management and the same modes of life in the owners, that have been already described when those districts were considered that bordered on the country which the primitive shepherds traversed. The fat-rumped sheep chiefly occupy Southern Tartary—the broad-tailed ones are found in Northern and Middle Asia. In the former there is considerable variety in the shape, and size, and fleece, and particularly in the number of horns. The four-horned sheep are numerous in several parts, and a few have six horns; the forehead is convex, and there are wattles under the throat. In the latter there is some, but less difference of size, and of accumulation of fat on the loins. They are more disposed to general good condition, and the quality of the fleece is better.

### THE ARGALI.

Amidst the highest mountains of Central Asia lives the ARGALI, deemed, by some authors, but erroneously so, the parent of all the varieties of the domestic sheep. He is one of the few remaining wild sheep; and as such, and on account of his superior size and beauty, as well as the relation in which he has been supposed to stand to sheep generally, deserves particular notice. The account given by Pallas will be chiefly followed, for he describes that which he had actually seen.

Before Siberia was colonised, the Argali used to frequent the lofty mountains extending from the river Irtisch to Kamtschatka; but now, shunning the neighbourhood of man, it has retreated to the more perfect deserts of Kamtschatka in the north, to the Mongolian and Songarian mountains towards the centre of Asia, and to the steeps of Caucasus in the south.

When it is found, it is usually on some barren but not very lofty rock, where it can bask itself in the rays of the sun, and see the possible approach of danger on every side. It does not, however, occupy the highest part of the mountains on which it grazes. The ibex, an inhabitant of the same rocks, ranges far above it. Although it flies to these precipices for security, it does not, like the ibex, delight in the cold, but seeks as warm a situation as such desert regions can afford.

The Argali is about the size of the fallow deer, but is very differently formed. Its legs and its neck are shorter, and the muscles of its limbs are stouter; it displays more bulk than the deer, and promises more strength than speed. The male is considerably larger and stouter than the female; he is three feet high at the withers, and sometimes weighs more than 200 pounds.

* Navarette's Account of China (Churchill's Collection), vol. i. p. 45.

The head is that of a ram, but the ears are small in proportion to the developement of the head, and erect. The horns are of an enormous size, nearly four feet in length, and with a hollow so considerable, that young foxes occasionally conceal themselves in those that have been accidentally shed. According to Major Smith, "they rise near the eyes, before the ears, occupying the greater part of the back of the head, and nearly touching above the forehead, bending at first backwards and downwards, then to the front, and the points finally outwards and upwards; the base is triangular; the broadest side towards the forehead, the surface wrinkled crossways to beyond their middle, and the extremity more smooth*." The horns, however, as in the subjoined cut, differ materially in different animals. The horns of the Argali of Caucasus are rounder, heavier, and larger throughout their whole course. The horn of either species, with its bony basis, will weigh 14lbs. or 15lbs.

The following is a cut of the head and horns of the Asiatic Argali, taken from a specimen in the collection of the Linnæan Society.

[*Asiatic Argali.*]

The summer coat consists of short hair, smooth, and resembling that of a deer. The winter coat has a longer external coat of hair, but concealing a thick and soft layer of wool. The colour is of a reddish-brown in summer, changing to a brownish-grey in winter; and the inner coat of wool is always white. Both in winter and summer there is a large disk of a buff colour on the haunch.

The horns of the female are shorter and smaller, and nearly straight; her colour is likewise paler, and there is no buff coloured spot on the haunch. The throat is covered with longer hair, and the tail is very short.

The Argalis are generally found in flocks of eight or ten in number. The males during the rutting season fight furiously; but otherwise this is a timid, or cowardly animal, and rarely offers resistance when pursued. They are said to breed twice in the year, viz., in spring and in autumn. The female seldom produces more than one at a birth, and the young lamb is covered with a soft, gray, curling fleece, as in many of the half-domesticated breeds of sheep, and which, by degrees, exhibits the usual mixture of hair and wool in these animals. From the commencement of the spring to the approach of winter, they pasture in the little secluded valleys, among the mountains, and become very fat, and in high request. As winter approaches they descend lower, and there, from scarcity of food and constant fear and alarm, they lose all their condition, and when the time arrives for their return to

* Animal Kingdom, vol. iv. p. 317.

the mountains, they are, except for the sake of their skins, comparatively worthless. When pursued they exhibit all the fear and peculiar gait and manner of the sheep; they run from side to side, and stop every moment to look at their pursuers; yet, as their flight is uniformly towards the most inaccessible parts of the mountains, the chase of them is frequently attended by no little danger. The young ones are very easily tamed, but no severity or kindness will render the adult animal tractable*.

A variety of the Argali is found in North America, and was long known by the name of the sheep of California. The Canadian free traders recognized it by the title of Culblane. The Abbé Lambert gives the following account of it:—"Besides several sorts of animals known among us, there are two sorts of fallow beasts unknown in Europe. They call them sheep, because they have the figure of our sheep. The first species is as large as a calf one or two years old. Their head has a great resemblance to that of a stag, and their horns to those of a ram. Their tail and hair, which are speckled, are shorter than those of a stag, their flesh is very good and delicate †."

Mr. M'Gillivray, in his account of his travels in the Rocky Mountains, gives the first scientific account of it. He describes it as resembling the Asiatic Argali in size and form, but having still larger horns, not quite so close at their roots, covering the greater part of the forehead, proceeding at first decidedly upwards, then turning suddenly downwards for nearly one third of the length of the neck, after this once more bending upwards, and terminating in a sharp point. The face and mouth white, the cheeks, neck, back, and limbs of a grey and rufous dun colour, and the tail and buttocks of a white buff.

They are found in troops of thirty or forty, on the steepest ridges of the mountains, but in winter they descend nearer to the plain.

The following cut is delineated from a specimen in the Museum of the Zoological Society of London.

[*American Argali.*]

Major Hamilton Smith adds, that "if the American species be the same as the Asiatic, which appears very probable, it can have reached the New World only over the ice by Behring's Straits; and the passage may be conjectured as comparatively of a recent date, since the Argali has not spread

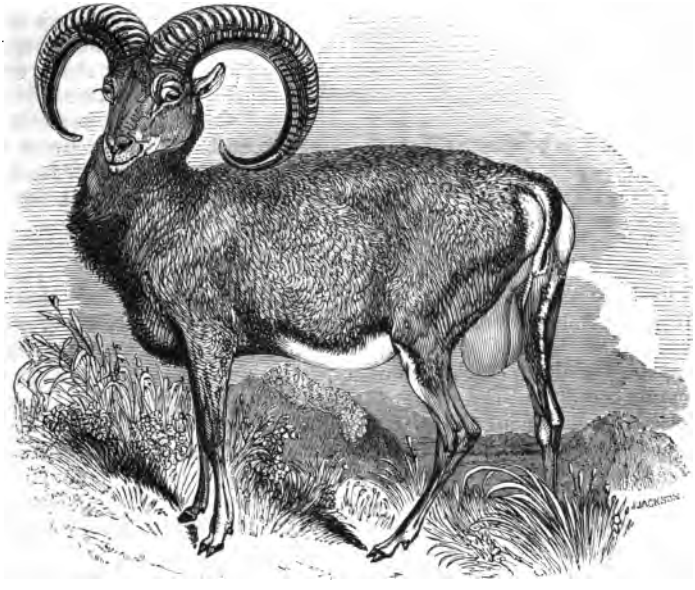
* Animal Kingdom, vol. iv. p. 318; Quarterly Journal of Agriculture, vol. ii. p. 369; Illustrations of Natural History, vol. i. p. 146; and Anderson on Sheep.

† Lambert's Observations on Asia, Africa, and America, vol. i. p. 130.

eastward beyond the Rocky Mountains, nor to the south farther than California*."

### THE MOUFLON OR MUSMON.

Buffon and Wilson have considered this sheep as identical with the Argali. Major Smith seems to regard it as a variety of the Argali. It will therefore be necessary, although travelling into another quarter of the world, to describe the mouflon. It inhabits the mountains of Corsica and Sardinia, and has been found in Crete, Cyprus, and some other of the islands of the Grecian Archipelago. It formerly abounded in Spain, and it was known to the early naturalists; Pliny describes it under the names of musmon and ophion. He says that "there is in Spain, but especially in the Island of Corsica, a kind of musmones not altogether unlike to sheep, having a shag more like the hair of goats than a fleece with sheep's wool. The kind which is engendered between them and sheep, they called in old time, *umbri*."



[*The Mouflon.*]

Mr. Wilson gives the most correct account of this animal. It is usually about two feet and a half in height, and three feet and a half from the nose to the commencement of the tail. The horns never exceed two feet in length; they are curved backwards, and the points turn inwards; the roots of the horns are very thick, and wrinkled; the ears are of a middle size, straight and pointed; there is the rudiment of a lachrymal opening as in the deer; the neck is thick; the body round; the limbs muscular; and the tail short. The colour is generally of a dull, or brownish-grey, with some white on the fore part of the face and on the legs; a tuft of longer hair beneath the throat; a dark streak along the back; and the upper part of the face black, with black streaks along the cheeks: the mouth, the nostrils, and the tongue are also black, and a spot of pale yellow is on the sides.

* Animal Kingdom, vol. iv. p. 319.

The forehead of this sheep is particularly arched. The females are generally without horns, and where they do appear, they are considerably less than those of the male.

The musmons rarely quit the highest parts of their native mountains; but the temperature of the countries in which these sheep are usually found does not admit of perpetual snow. They congregate in herds, seldom exceeding a hundred individuals, and, in the winter, the herds divide themselves into lesser groups, consisting of a male and a few females. The young ones are generally dropped in April or May, and are carefully attended to by their dams.

The musmon is covered by a fine hair of no great length, having beneath it a thick, grey-coloured wool, short, but full of spirals, and the edges thickly serrated*.

Cuvier says that domestication has little effect in developing any good quality in these animals, and that they rarely exhibit either intelligence, confidence, affection, or docility. He speaks of those that were in the Menagerie at Paris, of which he was the director; and his account very much coincides with observations made by the author of this work in the gardens of the Zoological Society of London. They were by many degrees more stupid and mischievous than any of the other breeds of sheep which that Menagerie contained. Major Hamilton Smith says, that their skins are used for various purposes; and in the islands of Corsica and Sardinia the mountaineers still convert them into vests, and a kind of cloaks, which may be the present representatives of those noticed in the Commentaries of Cæsar, as made from the skin of the *musmo* (musmon)—a dress that was much worn by the inland robbers†.

### NORTH AMERICAN SHEEP.

Until the introduction of the Merinos into North America little that was satisfactory could be affirmed of the sheep of any part of that country. Many portions of the United States, and even of Canada, possessed advantages for the breeding of sheep that were not surpassed in Europe. The country was undulating or hilly,—the hills covered with a fine herbage,—the enclosures more extensive than in the best breeding districts of England,—almost every pasture furnished with running water, and sheltered, more or less, by trees, against the summer's sun; yet the sheep were of the commonest kind: there was a prejudice against their meat; a prejudice against them altogether; and there was scarcely a district in which the wool was fit for any but the coarser kind of fabrics ‡.

It might have been thought to be the policy of the mother country to foster a prejudice of this kind, in order that her colonies might be as dependent as possible upon her; and particularly that her woollen manufactures might there find a ready sale: accordingly the American sheep, although somewhat differing in various districts, consisted chiefly of a coarse kind of Leicester, and these were originally of British breed. The "American Husbandry," published in 1776, describes the New England wool as "long and coarse, and manufactured into a rough kind of cloth, which is the only wear of the province, except the gentry, who wear the finer cloths of Britain."

* Wilson on Domestic Animals, in Quarterly Journal of Agriculture, vol. ii. p. 359. See also the Animal Kingdom, vol. iv. p. 322.

† Animal Kingdom, vol. iv. p. 324.

‡ A writer in the Farmer's Magazine thus expresses himself:—"In the western parts of Virginia sheep are well managed, for there is no prejudice against mutton. In the North Eastern States there are good sheep pastures, and a moderate dislike of mutton: but in Kentucky, the farmer would dine upon dry bread rather than taste his own mutton."

A writer in the Farmer's Journal, March, 1828, confirms this account, and applies it, but somewhat unfairly and unjustly, to the American sheep at that late period. "In a very few instances in British America I found a small number of the Leicester breed, but no good ones; but on my crossing the United States, I found none but ordinary, or what we should term very bad ones. The best American fleece I ever saw was not better than a middling Cambridge one, and in no place did I find any that would do for, or that could be applied to bombazine, or even fine stuff."

Mr. Livingston, who wrote in 1811, describes some exceptions to this general character of the American flocks. The first is a very singular one. "The Otter sheep were first discovered on some island on the eastern coast, and have spread to the adjoining states. The sheep are long bodied rather than large, and weigh about 15 lbs. a quarter. Their wool is of a medium fineness, and a medium length; but that which particularly characterises these sheep is the length of their bodies, and the shortness of their legs, and which are also turned out in such a manner as to appear rickety. They cannot run or jump, and they even walk with some difficulty. They appear as if their legs had been broken, and set by some awkward surgeon. They can scarcely exist in a deep country, and they cannot possibly be driven to a distant pasture or market *."

The Arlington long-woolled sheep, originally bred by General Washington, descended from a Persian ram and some ewes of the Bakewell flock. The sheep retain much of the form of the Improved Leicester, and the staple of the wool is occasionally 14 inches long; it is soft, silky, and white, and calculated for hose, camblets, serges, and other fine woollen fabrics.

A peculiar breed of sheep is found in Smith's Island, on the Eastern Cape of Virginia, and supposed to be the indigenous race of that part of the country. The size and form and fattening quality of the animal is far superior to those of the Merino—the fleece is heavier, being from five to nine inches in length, and it is so fine, as to be adapted for every purpose to which the Spanish wool can be applied. This account is given on the authority of Mr. Custis, the proprietor of the island; but further examination, although proving that the breed is valuable, both on account of its carcass and its wool, does not justify the high terms in which they have been frequently spoken of.

Since the prohibition of the exportation of British sheep has been removed, the finer Leicesters and other breeds have found their way across the Atlantic, and materially changed the character of some of the American flocks. The Merinos have also reached the United States, and have been used in several of the northern provinces in improving some of the best American breeds. Mr. Livingston was very zealous in effecting this, and the system has been extending with decided advantage: it has reached even to the British colonies. Mr. M'Gregor calculates the number of sheep in Canada and the other northern transatlantic colonies to be 1,247,658; and a writer in the Onondago Journal says that "it would not be wide of the truth to put the whole number of sheep in the Union at thirteen millions, which, yielding an average 3 lb. of wool per head, will give a product of thirty-nine millions of pounds, and constitute not an unimportant item in the estimate of national wealth." An increasing quantity of wool begins now to be imported by the mother country from her American Colonies, and from the United States. In 1833 it amounted to 335,649 lbs.; but on the other hand the exports of woollen manufactures from England to those countries amounted to nearly three millions of pounds sterling †.

* Essays on Sheep, p. 61.

† M'Culloch's Dictionary of Commerce, Art. Wool.

### WEST INDIAN SHEEP.

The Jamaica sheep have already been described (p. 59). They have been bred there since the first discovery of the island. They are small; but the flesh is good, and the wool, although deteriorated by admixture of hair, is peculiarly fine and soft. On account of this admixture, however, it has not been applied to any valuable manufacturing purpose. Little attention is paid to the cultivation of sheep in many of the West Indian Islands.

### SOUTH AMERICAN WOOL.

Almost the whole of the South American wool is the production of Spanish sheep that have been taken over there, and that have multiplied to a very great extent. Both the sheep and the fleece have considerably degenerated, and too many hairs having begun to mingle with the wool, and to over-top it. It is very little valued, and is used chiefly for making list for broad-cloths, carpets, and a few other coarse articles*. The natives of South America use it in the manufacture of mattresses, pouches, baizes, friezes, &c. 220,000 lbs. of it were imported into England in 1833, but on the other hand, the exports to South America in woollen manufacture were of the declared value of 658,000*l.*† In a report made to the French Agricultural Society respecting Brazil, a singular circumstance is mentioned respecting the sheep, which are said to be very much deteriorated, viz., that if any flock is kept ten years on the same pasturage, disease breaks out among them, and great numbers die,—but if they are transported to another soil, although at a very inconsiderable distance, they renovate and flourish anew ‡.

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## CHAPTER V.

The History of the European Breeds—the Russian—Wallachian—Moldavian—Greek—Cyprus—Sicilian—Italian—Piedmontese—Savoy—Swiss—Spanish, Stationary and Migratory—the Spanish Sheep in other countries—the Swedish sheep—French—Norwegian—Danish—Feroe—Iceland—Azores—German—Saxon—Silesian—Prussian—Hungarian—Hanoverian—Flemish—Anglo Merinos—Australian—Van Diemen's Land—Cape.

The survey of European sheep will commence in those districts that lie nearest to the habitation of the primitive breeds. Russia, therefore, will first be considered, the greater part of her extensive territory being to the present day traversed by wandering shepherds.

### THE RUSSIAN SHEEP.

Far more attention continues to be paid to the breeding of sheep, than that of cattle, through almost the whole of this immense empire. All the wandering tribes possess a great number of sheep. Many of the inferior Boors and Cossacks in southern Russia have flocks consisting of many hundreds of these animals.

The characters of the sheep differ materially in the various districts. Towards the north they are small, short-tailed, and bear a coarse and harsh wool. About the river Don, and still more towards the centre, and on the banks of the Dneiper, and in some districts of the Ukraine, they yield a better wool; and thence the greater part of the material for the inland cloth

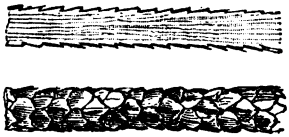
* Walton on Peruvian Sheep, 1811. † M'Culloch, Art. Wool.
‡ Annales de l'Agric. Fran. Jeuillat, 1834.

manufactories is supplied. In the neighbourhood of the Baltic a still superior breed is found, and the Dago and Oesel islands near the gulf of Finland are celebrated for their wool. The half-cloths that are manufactured from it have often as fine and close a substance as that which is imported from Great Britain. The finest of the Russian wools are exported from Odessa on the Black Sea. It is the produce of all the neighbouring provinces, but principally of the Crimea. There is no district in the empire so fitted by nature for the pasturage of sheep.

There are three kinds of sheep in the Crimea and in Taurida. The common breed is white, or black, or grey, with very coarse wool, and a long tail covered with fat. They are kept in exceedingly large flocks. A rich Tâtar will frequently possess 50,000 sheep. They wander from the mountains to the sea-coast, according to the season of the year. The grey sheep produce the grey lambskins, 30,000 of which are exported every year. During the independence and prosperity of that country, they were destined principally for Poland, where they were sold at a very high price. Fifty or sixty thousand black lambskins, which are also much valued, are exported from the Crimea.

The mountain sheep are smaller than those on the plains. Their wool is beautifully fine, and, even before the improvement which many of the flocks have undergone, used to find its way to the French manufactories. The Crimea was scarcely in the possession of Russia ere many attempts were made to improve the sheep, naturally so valuable. The Merinos were in process of time introduced here, as into every other part of Europe. A few have been cultivated as a pure flock; more have been employed in improving the native breeds, and the consequence is that the wool exported from Odessa is increasing in quantity and value every year. In 1828, 184,000 lbs. of wool were shipped from this port; in 1831 that quantity had increased to more than 1,260,000 lbs.*

The following is a delineation of a fine sample of Odessa wool:—



[*Odessa Wool—Transparent and Opaque.*]

The staple was from four to six inches in length; the curves numerous; and the general feeling of the wool very soft.

When viewed as a transparent object, the diameter of the fibre is $\frac{1}{750}$th of an inch, being the same as that of Lord Western's Merino wool, delineated in page 88. The serrations are 13 in the field of view, or 2080 to an inch —not so numerous as Lord Western's Merino, and much less so than the Saxony wool, page 89.

The serrations are distinct, and nearly at right angles, but not very hooked or prominent.

As an opaque object the leaves of the cup are beautifully distinct. They are long, and rather rounded, with a little peak in the centre, like the leaves of an artichoke.

This wool evidently possesses very high felting properties, and is a valuable material; but it is inferior to the Merino, and most decidedly so to the Saxony.

* M'Culloch's Dictionary, Art. Odessa. Pallas's Voyage in Russia, vol. i. p. 402.

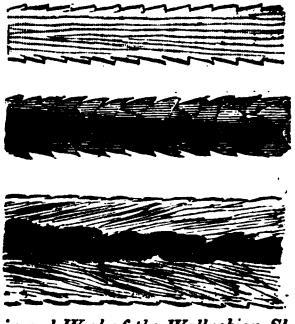
### THE WALLACHIAN SHEEP.

Proceeding down the coast of the Black Sea, the Wallachian sheep deserve attention. The great size and spiral form of the horns, and the long and silky-looking fleece, give them a noble appearance.

The following is the portrait of one of them in the Menagerie of the Zoological Society of London.

[*The Wallachian Sheep.*]

The horns differ as materially in the two sexes as they do in some of the British sheep. In the ram they usually spring almost perpendicularly from the ridge of the frontal bone, and then take a beautiful spiral form. In the female they protrude nearly at right angles from the head, and then become twisted in a singular way. The Wallachians are about the size of the Dorset sheep, but not so tall:—they are usually white, the ears are small and pendent, and the tail long; the fleece is also long—it is composed of mingled wool and hair—the hair having a few curves, and these producing a pleasing appearance on the back of the animal*. The wool of this sheep was submitted to the power of the microscope.



[*Hair and Wool of the Wallachian Sheep.*]

* Quarterly Journal of Agriculture, vol. ii. p. 542. Livingston on Sheep, p. 19. Illustrations of Nat. Hist. p. 145.

The hair is here viewed as a transparent object. It is $\frac{1}{1000}$th of an inch in diameter. It is decidedly serrated. There are 1600 serrations in the space of an inch. These are very irregularly placed, and there is a line running up the centre, giving the idea of a tubular structure.

The wool is deficient in curves; but it has 2080 serrations in an inch, and it is the $\frac{1}{750}$th part of an inch in diameter: the serrations are distinct and nearly at right angles. Viewed as an opaque object, it has a beautiful appearance, twenty or thirty little leaves or scales combining to form each cup.

In its native state, and with the great quantity of hair covering and diminishing the growth of the wool, the fleece of this sheep cannot be of much value for manufacturing purposes, but breeding would effect a great alteration. The hair could here, as on other sheep, be diminished—eradicated; the fineness of the fibre might be retained; the number of serrations increased, and the all-important spiral curve appended. Much of this has been done. The sheep now under consideration had spread from Wallachia through Hungary, Bohemia, and some other of the Austrian states. Its wool was not always shorn. Many of the lambs were killed, that fine cloaks, and other articles of clothing might be made of their skins with the wool on them. The skin of the adult sheep, with its wool on, was employed to make dresses for the peasantry. It was covered with oil or grease, and converted into a rude, but effectual mantle, clothed in which the shepherd or the woodman could brave any storm, and even sleep in the midst of snow. In many places these sheep have been shamefully neglected, and fed on the worst pastures; but since the introduction of the Merinos, much improvement has taken place in the fleece; and, what is of great importance, the old Wallachian sheep has disappeared over a great part of the country, and has been superseded by the Spanish one.

### THE MOLDAVIAN SHEEP.

These differ from the Wallachians chiefly in the length of the tail, the form of the horn, which is not so decidedly spiral, and the quality of the fleece. They carry two distinct species of wool, or rather a coat of hair, and another of wool. The hair is coarse—coarser than that of the Wallachian, and is 11 inches long. The wool is from 3 to 7 inches in length—finer than the hair, but not so fine as that yielded by the Wallachian.

The *Moravian* sheep are larger; they have a small head,—a back somewhat bowed, and they carry long wool, finer than that yielded by the Wallachian or Moldavian*. The change effected in all of them by the introduction of the Merino will be considered hereafter.

M. Lasteyrie speaks in strong terms of the bad management of the sheep in those countries before the recent improvements commenced. He says that these animals, when protected at all, were housed in confined buildings, without apertures, and from which the dung was removed only twice in the year. This treatment, and bad food during winter, occasioned frequent diseases in the flocks and herds, so that there were few countries where the murrain was so frequent or so disastrous†. Arthur Young confirms this. He is speaking of the Bohemian sheep:—"Wool generally sells well, but the price does not induce the farmers to increase their flocks, owing to the severe losses they are liable to, through all the imperial hereditary countries; for 600 or 700 in a flock will die in one night. The nature of the distemper is not known, but it is attributed to the excessive heat of the sheep-houses in which the animals are lodged‡." The far greater value of the Merino sheep,

* Lasteyrie on the Merino Sheep, p. 194. † Ditto, p. 196.
‡ Annals of Agriculture, vol. vi. p. 170.

and the consequent improved system of sheep-husbandry, have now banished this pest from the whole of the Germanic states.

### THE GREEK SHEEP.

The few fragments which related to the Grecian sheep were collected when the early history of this animal was considered. The present character and management of the sheep are in keeping with the oppressed and debased state of modern Greece. The Arcadian sheep seem to have retained most of their primitive excellence. They are 30 or 36 inches long, 16 or 18 high; weighing about 10 or 12 pounds the quarter; the head large, the countenance lively, the back broad, the chest round, the legs small, the wool thick, soft, and much curled *. This, with proper management, would seem to be a useful and profitable animal.

The flocks consist of about 500 sheep in each, under the care of three men and a boy. For the pasturage of each animal the owner pays one asper and a half † to the spahi of the village, who claims all the land as his property. Government demands another asper and a half per annum, and three aspers on each fleece. No provision is made for the food of the sheep during the winter, but they wander from one pasturage to another, according to the state of the season or the weather.

The profits of the flock are derived, firstly, from the lambs, which are contrived to be dropped near the coast in December, and among the hills in January. They are fed almost entirely on milk for two or three months; and at Easter, when there is a great consumption of lamb among the followers of the Greek church, they are worth from four to six piastres each ‡.

In March the ewes are separated from the lambs, and for the three following months are milked twice daily; then once a day for a month, and in July once in two or three days. A good ewe yields a pint of milk at each time. From this the Greeks ingeniously contrive to extract all the profit that it will yield. First, after having stood twenty-four hours in order to become sour, the milk is beaten in a narrow cask with a stick until the butter swims on the top. An equal quantity of fresh milk is then added to the buttermilk, and the manufacture of cheese commences. The first curd being removed, a tenth part of fresh milk is added to the whey; and, after a short boiling, a second coagulum is formed on the surface, termed *misithra*, and which is both palatable and nutritious. A superior variety of curd or cheese, and highly valued, is manufactured from the best new milk either of sheep or goats. A kind of rennet is prepared of the juice of a lemon mixed with flour and water that had been suffered to become sour, and then mixed with boiling milk. The new milk is boiled, and when it has cooled so as to bear a finger to be dipped into it, a small cupful of the rennet is poured into several quarts of the milk, and in three hours the curd is formed and fit for use.

The sheep-shearing season lasts from the middle of April to that of May. No washing or preparation is deemed necessary. The ewes yield three and the rams four pounds of wool, which sells for about ten paras § a pound. The greater part of this wool is exported, and the remainder is worked into coarse cloaks or carpeting. The skin, when sold unshorn, is worth from thirty to forty paras, and when converted into leather supplies most of the neighbouring islands.

* Agricult. Mag., April, 1802.
† An asper is about an eighth part of a penny.
‡ The piastre of 1816 is in value about 9¾*d.*
§ A para is three aspers, or three-eighths of a penny.

These sheep are subject to a pustular eruption (the *claveau* of the French), which destroys a great number of them. Inoculation with the matter of the pustule has been introduced with much success: a milder and more tractable disease is thus substituted. The rot is also very fatal in the Morea. Beef is little used for food in this part of Greece, but the mutton is much valued*. Only a very small number of sheep are found on any of the islands of the Greek Archipelago; but the inhabitants are principally dependent on Greece or Turkey for the supply of wool and hides, and mutton and beef.

### THE CYPRUS SHEEP.

The fat-tailed sheep are found in considerable numbers in this island, large in size, and the tail frequently weighing more than 50 pounds. They are of various colours, the white being most esteemed. The greater part of the wool used to be exported to Leghorn and to the south of France, in order to be used in the coarser manufactures.

Many of these sheep are policerate (having more than two horns). They all spring from the frontal bones, the crest of which is elevated in a peculiar manner, in order to form their base. The central horns are usually straight, or somewhat divaricating—occasionally they are spiral; the lateral ones assume almost every possible variety of curve. The following cut represents the most frequent appearance of the Cyprus four-horned sheep. This

[*Cyprus, or four-horned Sheep.*]

* Leake's Travels in the Morea.

multiplicity of horns is not found in any breed intrinsically of much value. It is generally accompanied by great length and coarseness of the fleece, and which, in the majority of these cases, assumes more the form of hair than of wool*.

### SICILIAN SHEEP.

An account, extracted from the earliest poet, has already been given of the supposed primitive management of the sheep in Sicily (pages 48, 49). A valuable breed of sheep is still found in this island, and, with regard to which, the same system of migration is pursued as in the Spanish flocks; but the wool is far inferior to that of the Merino. Livingston imagines that they are descendants from the stock of the ancient shepherds, and which had undergone all the improvement of which that race of animals was capable when Sicily was in its highest state of civilization†.

### ITALIAN SHEEP.

When Rome was in the zenith of her glory, the sheep of Italy seemed to be worthy of the soil on which they fed. "The best wool, of all others," says Pliny, "is that of Apulia (on the south of Naples); then that which in Italy is called the Greek sheep's wool, but in other countries is named the Italian (still more to the south, being that part of Italy which was particularly colonised by the Greeks). The Milesian (Asiatic) sheep and wool carry the third prize. The wool of Apulia is of a very short staple, and especially in request for cloaks and mantles about Tarentum (Taranto) and Canusium (Canosa); and as for whiteness, there is none better than that which groweth along the Po and in Lombardy‡."

If we are to credit the accounts of ancient authors, the Italian sheep and the Italian wool were cultivated with a care and assiduity which leaves all the precautions of modern times far behind. The reason of this was plain. The clothing of the richest and most refined people then in the world was at first made of wool: but at length the silk and cotton of the East gradually introduced themselves into Europe, and the Italians found the fabrics composed of these materials to be better adapted to the heat of the climate in which they lived. The consequence was that sheep began to be cultivated more for the carcass and less for the fleece; and the breeds of Apulia and Tarentum were rapidly deteriorated, and at length disappeared, and were succeeded by a larger, coarser, and hardier, but, under the altered circumstances, more profitable race§.

When, after the middle ages of darkness were passing away, the arts and manufactures again revived, Italy took the lead in the production of the

* Mariti's Travels in Cyprus, vol. i., pp. 35, 225. Anderson on Sheep, p. 41.

† The argument by which he enforces this opinion is at least a very ingenious one. "Those," (the sheep of Sicily,) "with most of the sheep I have seen in Italy, have pendent ears. From this circumstance I presume that they have been longer domesticated than those of Spain or the other parts of Europe; and as this country was originally settled by the Grecians, it is highly probable that the present race is from the stock of the first colonists: for, extraordinary as it may appear, notwithstanding the various changes which that country has undergone, its agriculture seems at the present to be what the poets describe it to have been two thousand years ago, and the implements of husbandry dug up at Pompeii and Herculaneum are evidently the models of those now in use in the vicinity of Naples.

"I consider pendent ears as a proof of very ancient domesticity, because I believe all wild animals carry theirs erect; and most, if not all of them, have the power of moving them to the point from which the sound is derived. When they cease to be their own protectors, and rely upon man both for defence and support, the organs given them with a view to these objects are gradually impaired, and the debility which results from their inaction changes their very form."—Livingston on Sheep, p. 44.

‡ Plin. Secund., lib. viii., cap. 48.

§ Bath Papers, vol. ii., p. 216.

finest and most costly woollen fabrics; but she no longer worked on her own materials, for her sheep would no longer yield her the means of competing with, much less surpassing, other countries. She had then recourse to the wools of Spain: thus Damianus, speaking of the exportation of wool from Spain, says that "those used in Italy, being the choicest, were sold for from forty to fifty gold ducats per sack." It would even seem that not a particle of her own wool was enwoven or capable of being enwoven in the fabric, for Richelius, in his 'Political Testament,' printed in 1635, speaking of the woollen manufactures of France, says that "they were preferred to those of all other countries except Venice, where they were made of Spanish wool*."

An extract from a modern work will show the altered and debased character of the Italian sheep previous to the introduction of the Merinos, of which mention will be presently made. "The sheep in the hill country near Rome are handsome, but of that kind whose fleece grows only on the back and half way down the sides. Black sheep are rather encouraged here for their wool, and the clothing of the friars is of this undyed wool. The clothing of the galley-slaves, which is partly worn without dyeing, is of a dark brown and white stripe. A kind of hard sourish cheese is made from the milk of the sheep, and they are profitable for the market, as they fatten easily. *The goats, however, are the most useful domestic animals*†."

Although the old Tarentine sheep produced a wool unequalled in early times, they were not without their defects, and very serious ones too. They were called by the agriculturists of those days *pellitæ* and *tectæ*, from the skins and other clothing with which they were covered; and also *molles*, not only from the softness of their fleece, but from the delicacy of their constitution, and the constant care that was required in order to preserve them from injurious vicissitudes of heat and cold. They are described as a most voracious breed; and any considerable or long-continued diminution of their food was attended with certain destruction of the flock. As there was no sale for the lambs, nor any profit from the milk, half of the young ones were destroyed at their birth, and each of the remaining ones suckled by two ewes—a sufficient proof that, like their probable descendants the Merinos, they were bad nurses. The ram-lambs were chiefly reared, and were castrated and killed at two years old, when, by means of constant clothing and compression, like the black lambs of Bucharia (see p. 53), an undulating gloss was given to the fleece, and it was sold at an advanced price. Notwithstanding this however, they are uniformly described as an unprofitable breed, for their carcasses were comparatively of little value, and they could not endure want or hardships, or the slightest neglect.

The preparation of this fleece was a work of great labour. It was frequently uncovered, not only to ascertain its condition, but for the refreshment of the animal; it was drawn out, and parted and combed, if it was beginning to mat; it was frequently moistened with the finest oil, and even with wine; it was well washed three or four times in the year; the sheep-houses were daily and almost hourly washed, and cleaned, and fumigated. The flocks were necessarily small, and the attendance and care expensive; and therefore it is not to be wondered at if, in the later periods of the Roman empire, and when the irruption of the barbarians commenced, they were gradually lost, or intermixed with the coarser-woolled native and uncultivated flocks of the country‡.

* Encyclopædia Londinensis, Article Wool.

† Graham's Three Months in Rome, 1821.

‡ The reader may see this subject well treated in a very ingenious pamphlet, entitled "On the Name and Origin of the Breed of Merino Sheep," published in 1811.

### THE PIEDMONTESE SHEEP.

Piedmont, and the country near the Alps, is celebrated by Pliny for its breed of grey fine-woolled sheep, and which vied with the choicest black wool of Spain, or white of Italy, or red of Asia*. These sheep never entirely degenerated; or rather, amidst the degeneracy of others, it was acknowledged that the wool of Piedmont and the Alpine region of Italy was excelled only by that of Spain †. The establishment of the Merino in Piedmont will be an interesting subject.

### THE SAVOY SHEEP.

Few sheep are kept in the valleys of Savoy, as it is necessary to house them during the winter, and no better food can be obtained for them than the dried leaves of trees. Poor families keep a few sheep to supply them with wool. "These little flocks," says Bakewell, "are driven home every evening, generally accompanied by a goat or a cow, a pig or an ass, and followed by a young girl spinning with a distaff. As they wind down the lower slopes of the mountains, they form the most picturesque groups for the pencil of the painter, and carry back the imagination to the ages of pastoral simplicity sung by the poets‡."

### SWISS SHEEP.

The Cantons of Switzerland produce various breeds of sheep, according to the mountainous character of the country and the richness of the pasture. In some of the valleys there are sheep not much unlike the long-woolled English breeds. They have been imported, or sheep to improve them have been procured, from Swabia, Flanders, and Great Britain. They average from 24 to 36 pounds the quarter when fatted. The rams yield from 10 to 14 pounds of wool in the grease, and the ewes from 6 to 8 pounds. This wool is somewhat, but not much inferior in quality to the Lincolnshire wool.

On the more irregular, yet not abrupt parts of the country, and where wheat and especially clover are grown, and particularly in the neighbourhood of Thun, a smaller breed of sheep is found. They produce a shorter wool, more adapted, at least according to the old system of manufacture, for the card than the comb. Those of a brown or black colour yield the finest wool.

Consistent, however, with the character of the country, the mountain sheep are the most numerous, and, on the whole, the most profitable. They are of a still smaller size, and they have much improved since the introduction of the Merinos into Switzerland; for their wool has not only increased in fineness, but it has doubled or tripled itself in weight. They are hardy, little susceptible of rot; they live and thrive longer than other breeds, and do not lose their teeth until they begin to get very old. They are from 20 to 24 inches in height, and from 3 feet 4 to 8 inches in the girth. They are shorter in the leg than mountain sheep are generally found to be, and will average, when fatted, from 20 to 24 pounds the quarter. The wool is fine, short, and proper for the card.

There are also several flocks of the pure Merinos, and of others between the Merinos and the native sheep, although the prejudice against this breed, now happily overcome, was perhaps greater in Switzerland than in any other part of Europe§.

* Plin. Secund., lib. viii., ch. 38. † Lasteyrie on the Merino Sheep, p. 105.
‡ Bakewell's Residence in Tarantasia, vol. i., p. 327.
§ Lullin sur les Bêtes à Laine dans les Environs de Genève, 1807.

## THE SPANISH SHEEP.

Before the sheep of the other European states are described, it will be proper to consider the Spanish sheep, the spread of which in different countries has, either directly or indirectly, effected a complete revolution in the character of the fleece.

The early writers on agriculture and the veterinary art describe various breeds of sheep as existing in Spain: they were of different colours—black, and red, and tawny. The black sheep yielded a fine fleece—the finest of that colour which was then known; but the red fleece of Bætica—Granada and Andalusia—was of still superior quality, and "had no fellow*."

These sheep were probably imported from Italy. They were the Tarentine breed, already described, and which had gradually spread from the coast of Syria and the Black Sea, and had now reached the western extremity of Europe. Many of them mingled with and improved the native breeds of Spain, while others continued to exist as a distinct race; and, meeting with a climate and a herbage suited to them, retained their original character and value, and were the progenitors of the Merinos of the present day. Columella, a colonist from Italy, and uncle to the writer of an excellent work on agriculture, resided in Bætica in the reign of the Emperor Claudius (A. D. 41). He introduced more of the Tarentine sheep into Spain, and he otherwise improved on the native breed; for, struck with the beauty of some African rams which were brought to Rome to be exhibited at the public games, he purchased them, and conveyed them to his farm in Spain. Hence, probably, the better varieties of the *Chunah*, or long-woolled breeds of Spain, that will presently come under consideration.

Previous, however, to the time of Columella, Spain possessed a valuable breed of sheep; for Strabo, who flourished under Tiberius, speaking of the beautiful woollen cloths that were worn by the Romans, says that the wool was brought from Truditania, in Spain†.

With regard to the extent of these improvements history is silent; but as Spain was at that time highly civilized, and as agriculture was the favourite pursuit of the greater part of the colonists that spread over the vast territory which then owned the Roman power, it is highly probable that the experiments of Columella laid the foundation for a general improvement in the Spanish sheep—an improvement which was not lost, nor even materially impaired, during the darker ages that succeeded‡.

* Plin. Sec., lib. viii., ch. 48. † Livingston's Essay on Sheep, p. 39.

‡ The following observations from an anonymous but valuable pamphlet, published in 1811, and entitled "On the Name and Origin of the Breed of Merino Sheep," will be interesting to many readers:—

"The original Spanish sheep were, according to Pliny, Solinus, and Columella, some black-fleeced; some produced red or Erythræan wool; and some, as those about Cordova, had a tawny fleece. The remains of these ancient varieties of colour may still be discerned in the modern Merino sheep. The plain and indeed the only reason that can be assigned for the union of black and grey faces with white bodies, in the same breed, is the frequent intermixture of black and white sheep, until the white prevails in the fleece, and the black is confined to the face and legs. It is still apt to break out occasionally in the individual, unless it is fixed and concentrated in the face and legs by repeated crosses and a careful selection; and, on the contrary, in the Merino South-down the black may be reduced by a few crosses to small spots about the legs, while the Merino hue o'erspreads the countenance. The Merino hue, so variously described as a velvet, a buff, a fawn, or a satin-coloured countenance, but in which a red tinge not unfrequently predominates, still indicates the original colours of the indigenous breeds of Spain; and the black wool, for which Spain was formerly so much distinguished, is still apt to break out occasionally in the legs and ears of the Merino race. In some flocks, half the ear is invariably brown, and a coarse black hair is often discernible in the finest pile. The Erythræan, the Fuscus, and perhaps the Pelligo of the ancient Spanish breeds, are pre-

In the eighth century the Saracens established themselves in Spain, and they found it fruitful in corn and pleasant in fruits, and "glutted with herds and flocks." The luxury of the Moorish sovereigns has been the theme of many a writer, and a rich and expensive dress has always been one of the leading articles of luxury: accordingly, in the thirteenth century, when the woollen manufacture was scarcely known in a great part of Europe, and in few places flourished, there were found in Seville no less than 16,000 looms. At the same period the cloths of Lerida were much esteemed. A century afterwards, Barcelona, and Perpignan, and Tortosa were celebrated for the fineness of their cloths, and the greater part of Europe, as well as the coast of Africa, was supplied with them; and, later than this, and in the time of Charles V., Spain was full of flocks and herds, and not only furnished its own people most abundantly, but also foreign nations, with the softest wool. In 1576 there were annually exported from Spain to Bruges alone 40,000 sacks of wool, each selling for at least 20 gold ducats (*9l. 5s.*); and others, of a finer kind, were sent to Italy at the price of 50 gold ducats (*23l. 2s. 6d.*) per sack*.

After the expulsion of the Saracens the woollen manufacture languished, and was in a manner lost, in Spain. Ferdinand V. banished nearly 100,000 industrious people because they were Moors; and for this worthy deed was honoured with the title of Catholic. His successor, Philip III., drove from Valentia more than 140,000 of the Mahometan inhabitants; and in the three following years 600,000 more were expelled from Murcia, Seville, and Granada. The majority of these people were artisans—weavers; and the natural consequence was that the 16,000 looms of Seville dwindled down to sixty, and the woollen manufacture almost ceased to have existence throughout Spain†.

The Spanish Government at length saw, but too late, its fatal error, and many attempts have been since fruitlessly made to produce again the beautiful fabrics of former days. All this while, however, the Spanish sheep seem to have withstood the baneful influence of almost total neglect. Until a few years ago, the Peninsula continued to possess the most valuable fine-woolled sheep; and will always have to boast that, although the Merino flocks and the Merino wool have improved under the more careful management of other countries, Europe and the world are originally indebted to Spain for the most valuable material in the manufacture of cloth.

It has already been mentioned (see p. 123) that Pedro IV. of Spain imported, for the supposed improvement of the Spanish sheep, several Barbary rams; and that, two hundred years afterwards, Cardinal Ximenes had recourse to African rams for the same purpose. Of the effect produced by these experiments there is no authentic account. It is probable that the Barbary sheep, like the Cotswolds of England, were employed in improving the coarser and long-woolled breed of Spanish sheep; and that the shorter and finer woolled sheep, the breed whence the present race of Merinos descended, were undebased by foreign admixture.

The perpetuation of the Merino sheep in all its purity, amidst the convulsions which changed the whole political existence of Spain, and de-

cisely the red or fawn, the buff or satin-coloured countenances of the Merinos at present; and whatever was the peculiar colour which the elder Columella introduced by means of African rams into his Tarentine flock, we may conclude that the same expedient was adopted by the agriculturists of Bætica to convert their coarse into fine-woolled breeds, and to communicate the purest white to the party-coloured fleece."

* Livingston, p. 41. See also an excellent and most satisfactory article on the Spanish Wool in the Encyclopædia Londinensis, vol. xxiv.

† See a very valuable pamphlet on the Woollen Manufacture, and not half so much known as it deserves, by Mr. Wansey.

stroyed every other national improvement, is a fact which the philosopher and the philanthropist may not be able fully to explain; but which he will contemplate with deep interest. In the mind of the agriculturist, it will beautifully illustrate the primary determining power of blood or breeding, and also the agency of soil and climate, a little too much underrated, perhaps, in modern times.

The Spanish sheep are divided into the *estantes* or *stationary*, and the *transhumantes** or *migratory*. The stationary sheep are those that remain during the whole of the year on a certain farm, or in a certain district, there being a sufficient provision for them in winter and in summer. The transhumantes wander some hundred miles, twice in the year, in search of pasture.

The *stationary* sheep consist of two breeds essentially different, and a third or intermediate one. The first is the *Chunah* breed: it is altogether distinct from the Merinos, being larger, taller, and heavier, with the head smaller and devoid of wool. The staple of this wool is eight inches long; it is much coarser than that of the Merino, and almost devoid of curve, and consequently of inferior value. This breed extends through almost the whole of Spain. It is the breed of the peasant and the little proprietor; and it is numerous even in those provinces where the Merinos are most extensively cultivated and most perfect.

It was probably in order to improve this coarser long-woolled breed that certain sheep were in the fifteenth century exported from England to Spain. There has been controversy whether they were Ryelands or Cotswolds; but Stow and Baker have, in their Chronicles, completely settled the question. The former says, "This yere (1464) King Edward IV. gave a licence to pass over certain *Cotteswolde* sheep into Spain." Baker adds, "King Edward IV. enters into a league with John, king of Arragon, to whom he sent a score of *Costal* ewes and four rams—a small present in show, but great in the event, for it proved of more benefit to Spain, and more detrimental to England, than could at first have been imagined." The fleece of the Cotswolds is fine, but the staple is long; and crosses with such sheep could only benefit a long-woolled flock. The Chunahs, therefore, may be descendants of the English sheep mixed with the common breed of the country; but further than this, England cannot, with any degree of justice, urge the claim which some have done, of being instrumental in producing the invaluable Spanish wool.

In the same way the known importation of English long wool into Spain may be accounted for. It was mixed with the coarser long wool of that country; it was that by means of which a greater quantity of the Spanish long wool could be used in the manufacture of certain articles, and particularly of the finer serges; and perhaps it may be said, by means of which it could be used at all except in the coarsest fabrics. It was in the Spanish worsted manufactures what the Spanish or German wools are to the English ones in the manufacture of cloth: they permit the use of a greater quantity of British growth, and materially improve the fabric in the construction of which they are employed.

The other principal breed of *stationary* sheep consists of true Merinos. They wander not from the district or the property on which they are bred. In form and in fleece they differ not from the migratory sheep. They are found chiefly on the pastures scattered among the Guadarrama mountains, the Somo Sierra ranges, and the whole country of Segovia. They amount to about two millions.

Beside these, and also stationary, and found in every part of Spain,

* From *trans* and *humus*, expressive of their change of climate and pasture.

are various mixed breeds, the produce of the Merinos and the Chunahs, and other native varieties of sheep. Their character and value differ according to the proportion of Merino blood in them; and where that considerably preponderates, they are often confounded with and substituted for the pure Merinos. The Chunahs and the mixed breeds amount to six millions.

The description of sheep most sought after, and by which so many countries have been enriched, is the *transhumantes*, or *migratory* ones—those which pass the summer in the mountains of the north, and the winter on the plains towards the south of Spain.

[*Merino Ram.*]

The first impression made by the Merino sheep on one unacquainted with its value would be unfavourable. The wool lying closer and thicker over the body than in most other breeds of sheep, and being abundant in yolk, is covered with a dirty crust, often full of cracks. The legs are long, yet small in the bone; the breast and the back are narrow, and the sides somewhat flat; the fore-shoulders and bosoms are heavy, and too much of their weight is carried on the coarser parts. The horns of the male are comparatively large, curved, and with more or less of a spiral form; the head is large, but the forehead rather low. A few of the females are horned, but, generally speaking, they are without horns. Both male and female have a peculiar coarse and unsightly growth of hair on the forehead and cheeks, which the careful sheepmaster cuts away before the shearing-time; the other part of the face has a pleasing and characteristic velvet appearance. Under the throat there is a singular looseness of skin, which gives them a remarkable appearance of throatiness, or hollowness in the neck*. The pile, when pressed upon, is hard and unyielding; it is so from

* Lord Somerville has some singular observations on this:—"The second property to be noted in this sheep is a tendency to throatiness, a pendulous skin under the throat, which is generally deemed a bad property in this country, and the very reverse in Spain, where it is much esteemed, because it is supposed to denote a tendency both to wool and

the thickness with which it grows on the pelt, and the abundance of the yolk, detaining all the dirt and gravel which falls upon it: but, when examined, the fibre exceeds in fineness, and in the number of serrations and curves, that which any other sheep in the world produces. The average weight of the fleece in Spain is eight pounds from the ram, and five from the ewe. The staple differs in length in different provinces. When fatted, these sheep will weigh from twelve to sixteen pounds per quarter.

The excellency of the Merinos consists in the unexampled fineness and felting property of their wool, and in the weight of it yielded by each individual sheep; the closeness of that wool, and the luxuriance of the yolk, which enables them to support extremes of cold and wet quite as well as any other breed; the easiness with which they adapt themselves to every change of climate, and thrive and retain, with common care, all their fineness of wool, under a burning tropical sun, and in the frozen regions of the north; an appetite which renders them apparently satisfied with the coarsest food; a quietness and patience into whatever pasture they are turned, and a gentleness and tractableness not excelled in any other breed.

Their defects, partly attributable to the breed, but more to the improper mode of treatment to which they are occasionally subjected, are, their unthrifty and unprofitable form; a voraciousness of appetite which yields no adequate return of condition; a tendency to abortion or to barrenness; a difficulty of yeaning; a paucity of milk, and a too frequent neglect of their young. They are likewise said, notwithstanding the fineness of their wool and the beautiful red colour of the skin when the fleece is parted, to be more subject to cutaneous affections than most other breeds. Man, however, has far more to do with this than Nature. Everything was sacrificed in Spain to fineness and quantity of wool. These were supposed to be connected with equality of temperature, or at least with freedom from exposure to cold; and therefore twice in the year a journey of four hundred miles was undertaken, at the rate of eighty or a hundred miles per week, and the spring journey commencing when the lambs were scarcely four months old. It is difficult to say in what way the wool of the migratory sheep was or could be benefited by these periodical journeys. It is true that among them is found the finest and the most valuable wool in Spain. The Leonese fleece will at all times sell for considerably more per pound than that of any other Spanish sheep; but on the other hand, the estantes of Segovia are more valuable than the transhumantes of Soria. Sir Joseph Banks goes farther, for he says that "Burgoyne tells us that there are stationary flocks both in Leon and Estremadura, which produce wool quite as good as that of the transhumantes*." In addition to this is the now acknowledged fact that the fleece of some of the German Merinos, who travel not at all, and are housed all the winter, as much exceeds that obtained from the Leonese sheep in fineness and felting property, as the Leonese fleece exceeds the Sorian; and the wool of the migratory sheep is comparatively driven out of the market by that from sheep which never travel†. At all events the

to a heavy fleece." In every breed in this kingdom which has come under the author's observation he has invariably found the throaty sheep not good in their skins, and with no aptitude to fatten, with the exception perhaps of the Ryelands. — Somerville on Sheep, p. 16.

* Communications to the Board of Agriculture, vol. vi. p. 2.

† Professor M'Culloch gives the following scale of the prices of wool in the London markets, March, 1834:—

| Spanish: — | | s. | d. | | s. | d. |
|---|---|---|---|---|---|---|
| Leonessa | Per lb. | 2 | 6 | to | 4 | 0 |
| Segovia | | 2 | 6 | — | 3 | 6 |
| Soria | | 2 | 6 | — | 3 | 0 |

Caceres

advantages derived from the *Mesta* are overrated so far as the fleece is concerned; while with respect to the carcass, by these harassing journeys, occupying one quarter of the year, the possibility of fattening and the tendency to fatten must be destroyed, and the form and the constitution of the flock generally deteriorated, and the lives of many sacrificed.

The migratory sheep may be divided into two classes, or immense flocks—the Leonese and the Sorians. The Leonese, among which are the Negrettes, after having been cantoned during the winter on the north bank of the Guadiana, in Estremadura, begin their march about the 15th of April in divisions of two or three thousands. They pass the Tagus at Almares, and direct their course towards Trecasas, Alfaro, and L'Epinar, where they are shorn. This operation having been performed, they recommence their travels towards the kingdom of Leon. Some halt on the Sierra (ridge of mountains) which separates Old from New Castile, but others pursue their route to the pastures of Cervera, near Aquilar del Campo. Here they graze until the end of September, when they commence their return to Estremadura.

The Sorian sheep, having passed the winter on the confines of Estremadura, Andalusia, and New Castile, begin their route about the same time. They pass the Tagus at Talavera, and approach Madrid; thence they proceed to Soria, where a portion of them are distributed over the neighbouring mountains, while the others cross the Ebro in order to proceed to Navarre and the Pyrenees*.

| Per lb. | s. | d. | | s. | d. |
|---|---|---|---|---|---|
| Caceres | 2 | 9 | — | 3 | 6 |
| Seville | 2 | 0 | — | 2 | 9 |
| Portugal | 1 | 7 | — | 2 | 0 |
| Lambs' Wool | 1 | 9 | — | 1 | 10½ |
| **German, Saxon and Silesian:—** | | | | | |
| 1st and 2nd elect | 4 | 9 | — | 5 | 3 |
| Prima | 4 | 9 | — | 5 | 0 |
| Secunda | 3 | 0 | — | 3 | 6 |
| Tertia | 2 | 2 | — | 2 | 6 |
| **Austrian, Bohemian, and Hungarian:—** | | | | | |
| Electoral | 4 | 0 | — | 5 | 6 |
| Prima | 3 | 6 | — | 4 | 6 |
| Secunda | 2 | 6 | — | 3 | 6 |
| Tertia | 2 | 0 | — | 3 | 0 |
| Lambs | 2 | 9 | — | 4 | 6 |
| Pieces | 2 | 6 | — | 4 | 0 |
| Fribs | 1 | 9 | — | 2 | 9 |
| **Australian:—** | | | | | |
| Best flocks, superior fleeces | 3 | 6 | — | 4 | 6 |
| Seconds | 2 | 9 | — | 3 | 10 |
| Inferior flocks | 2 | 3 | — | 2 | 9 |
| **Van Dieman's Land:—** | | | | | |
| Inferior | 1 | 0 | — | 1 | 9 |
| Middling | 1 | 10 | — | 2 | 1 |
| Combing | 0 | 0 | — | 0 | 0 |
| Superior | 2 | 6 | — | 2 | 11 |
| Cape | 1 | 0 | — | 1 | 11 |
| **British Fleeces:—** | | | | | |
| North and South Down Hoggets | 2 | 0 | — | 2 | 2 |
| Half bred ditto | 2 | 0 | — | 2 | 2 |
| Ditto, ewes' clothing | 1 | 10 | — | 2 | 0 |
| Kent fleeces | 2 | 1 | — | 0 | 0 |
| Combing skins | 1 | 8 | — | 1 | 10 |
| Ditto, flannel wool | 1 | 8 | — | 1 | 10 |
| Ditto, blanket ditto | 1 | 3 | — | 1 | 6 |
| Leicester fleeces | 1 | 6 | — | 2 | 0 |
| In Yolk Devons | 0 | 10 | — | 0 | 0 |
| Ditto, Down | 1 | 0 | — | 0 | 0 |
| Ditto, Merino | 1 | 0 | — | 1 | 4 |
| Goats' wool, Turkey | 1 | 6 | — | 1 | 6½ |

* Tessier, Inst. des Bêtes à Laine. Dillon's Travels in Spain in 1779.

These periodical journeys can be traced back to the middle of the fourteenth century, when a tribunal was established for their regulation. It was called the *Mesta* (the derivation of this term is disputed), and consisted then, and continues to consist, of the chief proprietors of these migratory flocks. It established a right to graze on all the open and common land that lay in the way; it claimed also a path ninety yards wide through all the enclosed and cultivated country; and it prohibited all persons, even foot passengers, from travelling on these roads while the sheep were in motion.

The number of migratory sheep is calculated at ten millions. They are divided into flocks, each of which is placed under the care of a *mayoral*, or chief shepherd, who has a sufficient number of others under his command, with their dogs*. He uniformly precedes the flock, and directs the length and speed of the journey; the others with the dogs follow, and flank the cavalcade, collect the stragglers, and keep off the wolves, who regularly follow at a distance and migrate with the flock. A few asses or mules accompany the procession, in order to carry the little clothing and other necessaries of the shepherds, and the materials for the fold at night. Several of the sheep, principally wethers, are perfectly tamed, and taught to obey the signals of the shepherds. These follow the leading shepherd, having been accustomed to be fed from his hand; they lead the flock—there is no driving—and the rest quietly follow.

When passing through the enclosures, they sometimes travel eighteen or twenty miles a day; but when they reach an open country, with good pasture, they proceed more leisurely. Their whole journey is usually more than four hundred miles, which they accomplish in six weeks, and thus spend, in going and returning, nearly one quarter of the year in this injurious manner.

It may be readily supposed that much damage is done, carelessly, or unintentionally, or wilfully, to the country over which these immense flocks are passing; and particularly as the migrations take place at the times of the year when the property of the agriculturist is most liable to injury. In the spring the corn has attained considerable height, and in the autumn the vines are laden with grapes. The commons also are so completely eaten down by the immense number of migratory sheep, that those which belong to the neighbourhood are, for a period, half starved. In addition to this, the servants of the Mesta, like the servants of Government elsewhere, have little common feeling with the inhabitants of the country which they are traversing; they commit much serious and wanton injury, and they refuse all redress.

The shepherds and the sheep equally know when the procession has arrived at the point of its destination. It is necessary to exert great vigilance over the flock during the last three or four days, for the animals are eager to start

* "The Spanish sheep-dogs are used entirely for the defence of the flock against the wolves, and in case of attack the sheep fly to, and gather round them as their friends and protectors. They are also taught, if a sheep lags behind unobserved by the shepherds, to stay with it and defend it until some one returns in search of it. If the shepherd wishes to remove the flock, he calls to him a tame wether, accustomed to feed from his hands, of which a few are kept in every flock; and these, however distant, obey the call, and the rest follow. With us, dogs are too often used for other and worse purposes. In open, uninclosed districts, they are indispensable, but in others, I wish them, I confess, either better managed, or encouraged less. If a sheep commits a fault in the sight of an intemperate shepherd, or accidentally offends him, he is *dogged* into obedience. The signal is given—the dog obeys the mandate, and the poor sheep flies round the field to escape from the fangs of him who should be its protector, until it becomes half dead with fright and exhaustion, while the trembling flock crowd together, dreading the same fate; and the churl exults in this cowardly victory over a weak and defenceless animal."—Trimmer on the Merinos, p. 50.

away, and often great numbers of them make their escape. If they are not destroyed by the wolves, there is no other danger, however, of losing them; for they are found on their old pasture, quietly waiting the arrival of their companions, and it would be difficult to make any of them proceed a great way beyond this spot. Even the stray sheep are generally found on the particular unfenced portion of ground, called a *dehesa*, which is allotted for the flock to which they belong *. The shepherds are immediately employed in constructing pens for the protection of the sheep during the night, and which are composed of ropes made by twisting certain rushes together which grow plentifully there, and attaching them to stakes driven into the ground. They next build, with the branches of trees roughly hewn, rude huts for themselves.

When the sheep arrive at their summer pasture, which at first is very luxuriant, the *mayoral* endeavours to guard against the possible ill effect of the change from the uncertain and scanty pasturage found on the journey, by giving the flock a considerable quantity of salt. He places a great many flat stones five or six feet from each other, and strews salt upon them; he then leads his flock slowly through the avenue of stones, and they devour the salt with great avidity. This is repeated on several successive days; and a case of general inflammation, or of hoove—the penalty too often paid by shepherds elsewhere for turning their flock unprepared on new and rich herbage—seldom occurs among the Spanish sheep.

During the summer pasturage the labour of the shepherd is light. The ewes are put to the rams early in August. After their return at the close of autumn, and when yeaning-time approaches, the barren ewes are separated from the others and placed on the poorest pasture. The Merinos are not good nurses, and nearly half of the lambs—or in bad seasons, and when the pasture fails, full three-fourths—are destroyed as soon as they are yeaned. The males are always sacrificed first: the others are usually suckled by two ewes—for it is a common opinion in Spain that the mother that fully suckles her lamb would yield less wool: they are afterwards placed on the best pasture, in order that they may acquire sufficient strength for their approaching journey. The number of lambs slaughtered is sometimes so great that they are sold to the neighbouring villagers for less than half a franc each. Most of the skins are sent into Portugal, and thence find their way to England, where they are used for the manufacture of gloves. Morning gowns, both light and of good appearance, are frequently made from the skins. The wool is soft and silky, and is formed into little rings or curls.

Few of the male lambs are castrated, because it is believed that the weight of the fleece is much increased on the ram, without acquiring proportional coarseness. The shepherd, however, early in March, has four operations to perform on the lambs: he cuts off their tails five inches below the rump,

* The country in which the sheep are to be pastured, both in the southern and northern parts, is set out into divisions, separated from each other by landmarks only. Each division is supposed to be capable of maintaining a flock of a thousand sheep. To each division the different flocks are rigorously confined.

This accounts for a peculiarity observed in the imported Merinos, in Britain, and in the Anglo-Merinos also. A writer in the Farmer's Magazine, November, 1826, says of them:—"They range all in one lot, that is, of whatever number the flock consists, it is found all in one place, feeding like a drove passing through a country. They are either on one of the spots of fine grass, or travelling from one to another. Nothing will induce them to do what the shepherds call 'lying abroad' upon the waste, or mingle with sheep of any other kind. After taking their walk every day over their range of pasture, they form a sort of camp at night, on the highest part of their ground, and may be certainly found there at day-break next morning, lying so closely, that they touch each other; the stronger sheep outside, and the weakest in the centre."

for the sake of cleanliness; he marks them on the nose with a hot iron; he cuts off the tips of their horns that they may not hurt each other in their frolics*, and he castrates those which, from their superior strength, and superior size, he has selected to become bell-wethers, and lead the flock in their peregrinations. This last operation is performed according to the French method, by squeezing the scrotum, and twisting the spermatic vessels.

April having arrived, the sheep begin to exhibit great anxiety to set out on their periodical migration, and make every effort to escape. If their purpose is accomplished, they start away in the proper direction, but ere they have traversed the 400 miles they are generally the prey of the wolves†.

It is supposed that forty or fifty thousand men are employed in these peregrinations of the sheep. They are a singular race of men, enthusiastically attached to their profession, rarely quitting it, even for a more lucrative one, and rarely marrying. In the winter they live in the rude constructed huts already described,—but in the summer, or when they are on their travels, they sleep on the ground wrapped in their cloaks. Their chief food is bread, seasoned with oil or grease. Occasionally they eat their old sheep, or such as die of disease, but mutton is not their favourite food. The number of dogs kept for the purpose of guarding the sheep exceeds thirty thousand.

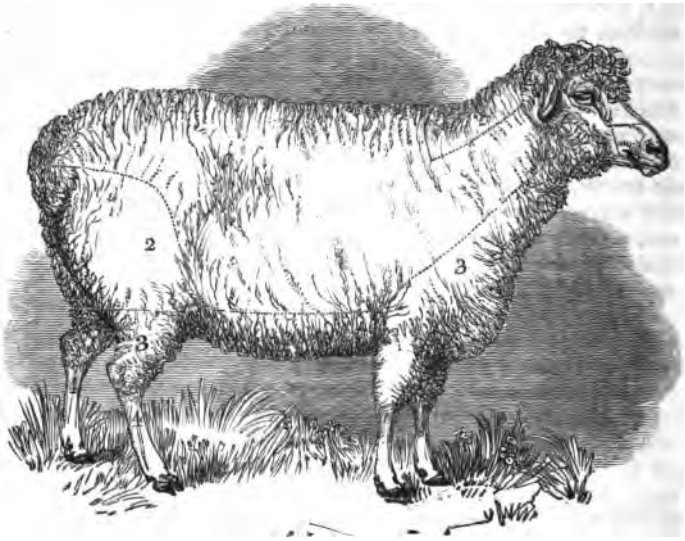
The shearing does not delay the flock more than a day. Buildings (*esquileos*) are erected at various places in the early portion of their journey; they are very simply constructed, and consist only of two large rooms, each of which will contain more than a thousand sheep; there is also a narrow, low, long hut adjoining, termed the *sweating-house*. The sheep are all driven into one of these apartments, and in the evening those intended to be shorn on the following day are transferred into the low long hut. As many are forced into it as it will possibly hold, and there they are left during the night. As some are liberated in the morning, the others are urged towards the end of the hut, while more from the apartment occupy their situation. In consequence of this close confinement they are thrown into a state of great perspiration; the yolk, which formed a somewhat hard crust on the fleece, is melted, and thus the whole is rendered softer, and is more easily cut. There is no previous washing, nor any other preparation for the shearing. From 150 to 200 shearers are generally collected at the esquileo, and a flock of a thousand sheep is disposed of in a day, although five rams or eight ewes are reckoned a good day's work for a Spanish shearer. The sheep are turned back as they are shorn into the second apartment, and on the same or the following day continue their journey; thus in the space of six days, as many flocks, each consisting of a thousand sheep, pass through the *esquileo*, and leave their

* The mode in which the Spanish shepherds cut off the horns is singular and brutal. It is not consistent with their usual kindness and gentleness to their flocks. "A ditch is made, which in length and breadth is about the size of a sheep, while in depth it is about five or six inches; and another is formed rather smaller than the former at one end of it, the two thus forming together a cross. In the last ditch, which is still more shallow than the other, a large plank is fixed to support the head of the ram when he lies on his back in the one which forms the trunk of the cross. A man stretches his body over that of the sheep, and holds the head forcibly upon the board with one hand, while with the other he holds a large chisel, weighing four or five pounds, which is then fixed upon the horn, and another man striking with a mallet, the part intended to be removed flies off at one or two blows."—Lasteyrie on Sheep, p. 226.—How much more simple would be the use of a fine saw!

† See Dillon's Travels in Spain. Livingston on Sheep, and Communications to the Board of Agriculture, vol. vi.

fleece behind them. The wool is then washed and sorted in the *esquileo*, and is ready for sale*.

The Merino fleece is in Spain sorted into four parcels. The following cut, while it contains the portrait of a Merino ewe, points out the parts whence the different wools are generally procured. The division cannot always be accurate, and especially in sheep of an inferior quality, but it is more to be depended upon in the Merino sheep wherever found, for the fleece is more equally good, and the quantity of really bad wool is very small.




[*Merino Ewe.*]

* The writer of an excellent article on wool very properly observes that "the management of the flocks is peculiarly Roman, and shows the Italian origin of these sheep. The Merino *mayoral* corresponds exactly with the *magister pecoris* of Varro and Columella, and was superior to the *opiliones* and *pastores*. The practice of destroying half the sheep at their birth, and of suckling each of the survivors on two ewes; of sweating the sheep before they were shorn, in order to increase the softness of the fleece, and of conducting them from their high winter to their summer stations, by long journeys through public sheep-walks, have been derived from Roman institutions; with this difference, that in Italy their migrations were confined to the coarse woolled sheep, while the molles oves, or fine woolled flocks of antiquity, were always housed."—Encyclop. Londinensis.

A condensation of Arthur Young's account of the Catalonian or Pyrenean breed will complete the account of the migratory sheep of Spain. The journeys of these sheep are smaller, and performed in a different manner. On the northern side of the Spanish portion of the Pyrenees are two mountains, the sides of which are covered with short, but plentiful herbage, and from one to the other of which the sheep are continually travelling during the summer. In the winter they are sent into the lower part of Catalonia, a journey of twelve or thirteen days, and when the snow begins to melt in the spring they are conducted back again to the mountains; thus they are kept the whole year in motion, they are never housed or under cover, and never taste of any food but what they find for themselves.

The author had the opportunity of examining a flock of these Catalonian sheep, consisting of about 2000. They were generally polled, but a few, both of the rams and ewes, had horns. The legs were white or reddish—the faces, some white, some red, and some speckled, and some with a tuft of wool on their faces; the carcass was round, the back straight; they were in good condition; would weigh, when fat, from 15 to 18 pounds per quarter, and resembled, on the whole, the South Down breeds.

Mr. Young wished to examine them more closely, and intimated this to the shepherd,

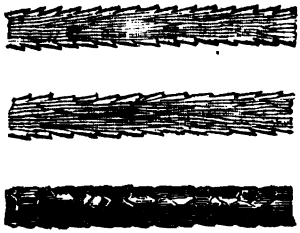
Both Lasteyrie and Livingston agree in this division*. The *refina*, (fig. 1.) or the picklock wool, begins at the withers, and extends along the back to the setting on of the tail. It reaches only a little way down at the quarters, but, dipping down at the flanks, takes in all the superior part of the chest, and the middle of the side of the neck to the angle of the lower jaw. The *fina*, (fig. 2.) a valuable wool, but not so deeply serrated, or possessing so many curves as the *refina*, occupies the belly, and the quarters and thighs, down to the stifle joint. The *terceira*, (fig. 3.) or wool of the third quality, is found on the head, the throat, the lower part of the neck, and the shoulders, terminating at the elbow: the wool yielded by the legs, and reaching from the stifle to a little below the hock, forms a part of the same division. A small quantity of very inferior wool is procured from the tuft that grows on the forehead and cheeks—from the tail, and from the legs below the hock. (fig. 4.)

A cut was given of the Long Merino wool of Lord Weston, in page 88. The reader is now presented with one of the picklock wool, from a Merino of the Negretti breed; it was beautifully curved. Being viewed as a transparent object, the serrations are not so prominent as in the Long Merino, but they are more regular and more numerous; they are 64 in the 40th part of an inch, or 2560 in the space of an inch. It is likewise very fine, being only the $\frac{1}{7160}$th part of an inch in diameter.

[*Picklock Merino.*]

Considered as an opaque object, the edges of the cup have a very singular vandyked serration, resembling a pine or fir-apple.

The next cut gives the fibre of a fair sample of good Merino wool, probably the *fina*. The diameter of the fibre is the same—$\frac{1}{7160}$th of an inch,



[*Common Merino.*]

who immediately walked into the flock, and singled out a ram, and bid it to follow him, holding out his hand as if to give him something. The animal immediately came with the shepherd, and submitted itself to Mr. Young's inspection. He found that mellowness of the skin which is the surest proof of a good breed, and a tendency to fatten. The wool was beautifully soft and fine, and weighed, as he imagined, about eight pounds; the average weight of the fleece was usually about four or five pounds. Four shepherds, provided with fire-arms, and four or five large Spanish dogs, had the care of the flock. The sheep were collected together every night on a particular spot,—the shepherd slept in a little hut close by, and the dogs gave certain notice of the approach of danger. During the day the head shepherd sat on the mountain top, or on an elevated spot, whence he could see everywhere around him, while the flock browsed on the declivities.—Annals of Agriculture, vol. viii. p. 195.

* See Lasteyrie and Livingston on the Merino Sheep.

—but the serrations, when it is viewed as a transparent object, are but 60 in the 40th of an inch, or 2400 in an inch, being a sufficient difference to account for its diminished usefulness and price.

The central figure is a fibre of the same wool that has undergone the process of combing. The serrations are more irregular—they are partially, and some of them almost entirely, torn away. The felting property is evidently impaired, as the experience of the manufacturer shows it to be.

When viewed as an opaque object, the edge of the cups appears to be only lightly serrated, and although there are indications of the vandyked form of the picklock, the character is not so determined.

Lasteyrie, than whom there can be no better judge, thus describes the distinction between, and the comparative excellence of, the different flocks of Leonese Transhumantes.

The *Escurial* breed is supposed to possess the finest wool of all the migratory sheep. The *Guadeloupe* have the most perfect form, and are likewise celebrated for the quantity and quality of their wool. The *Paulars* bear much wool of a fine quality; but they have a more evident enlargement behind the ears, and a greater degree of *throatiness*, and their lambs have a coarse hairy appearance, which is succeeded by excellent wool. The lambs of the *Infantados* have the same hairy coat when young. The *Negretti* are the largest and strongest of all the Spanish travelling sheep*.

Mention has been made of the perfection of the cloth manufactures of Spain. It does not, however, clearly appear whether the cloths so celebrated were of a sergelike and open, or a close and felted structure,—whether they were made of a long or short wool—of the fleece of the Churrahs, or of the improved Merinos. Many circumstances would induce the suspicion that these goods were produced by the agency of the comb more than of the card; at least it is now notoriously the fact, that there is scarcely a manufactory of fine felted cloth that deserves consideration in the whole of Spain. In 1791, Thomas Bevian, of Melksham in Wiltshire, was engaged by the Spanish monarch, and established, at considerable expense, at Guadalajara, where there were previously considerable manufactories of serges, with a view of endeavouring to consume a portion of their own fine wool in their own country; but the scheme was soon dropped. Either the natural indolence of the Spaniards could not be sufficiently roused, or the minds of the people soon became exclusively occupied by political matters; or they thought, or, perhaps, found it more profitable to sell their fine wools to foreigners, than to fabricate them themselves. The woollen manufacture has to a considerable degree increased, but it has been the manufacture of serges, and even in them the Spaniards cannot compete with the Flemish or the English†.

When the Spanish fine wool first began to be so important an article of commerce is not known, but incidental mention is made of it as early as the 14th century. In the 15th century, it obtained a considerable price. A Spanish vessel bound for the Netherlands having been taken by an English privateer, the owners lodged a claim for damages, stating that the wool was worth 9*l.* 12*s.* per sack of 364 lbs., or about 6*d.* a pound‡.

The Spanish wool gradually became an important branch of English commerce. In the year 1800, three millions of pounds of Spanish fine wool were imported. This increased in 1810 to nearly 6 millions of pounds. In

* Lasteyrie on Sheep, p. 23.
† Wansey on Wool, p. 303.
‡ Anderson's History of Commerce, anno 1478.

1825 the importation exceeded 8 millions of pounds, but in 1832, when the Merinos had spread into Germany, and particularly into Saxony, and a wool, the staple of which was finer, and possessed more numerous curves and serrations, was produced there, the importation diminished to about two millions and a half*. A wool approximating in quality to the Spanish is now beginning to arrive from the British colonies, and its finest samples produce a higher price in the market than the Spanish.

Another reason, perhaps, of the diminished importation of Spanish wool is, that its average price is no longer what the Spanish breeder expects, or which he may fairly deem a remunerating one; and, therefore, he will not send so much of it as he used to do.

The Spanish wool, however, continues to be highly valued by the manufacturer; and the Spanish breed of sheep will be regarded with interest as the improver of the best old short-woolled ones, and the parent of a new race, spreading through every quarter of the world, and with which, so far as the fleece is concerned, none of the old breeds can be for a moment compared.

The progress of the Merino sheep through the various countries of Europe, and of every quarter of the world, may now be more satisfactorily and usefully traced. The principal authority for the statements that will be given is Mr. Lasteyrie, whose work abounds with useful information.

### THE SWEDISH SHEEP.

The native sheep of Sweden are far from being a valuable breed. They are of moderate size, but the body is long and slender,—the legs also are long, and bare of wool,—the head small, the horns short, the fleece open, coarse in quality, and of a medium length; they are hardy in constitution —they care not for the rigour of the climate, and their flesh is good, although not overburdened with fat. It was evident that Sweden could support a better animal, for the herbage, although short, was thick and nutritive; and although the winter was often rigorous, the face of the country was such as to afford some shelter from the storm. Accordingly many attempts were made to improve the breed by means of foreign crosses. Recourse was had, and with considerable but variable success, to the German and Flemish sheep, and to the Leicester and Cheviots from Britain.

At length arose the wish to establish a fine woolled breed in Sweden, and it is singular that this northern country should be the first to import the sheep of the south, and to succeed to a very important extent in naturalizing them.

Mr. Alstroemer, in 1723, imported a small flock of Merinos. It was a hazardous—it appeared to be a presumptuous, an almost insane attempt; and this spirited individual had to struggle with seemingly insuperable obstacles. He, however, succeeded in collecting his little stock of southern sheep, and in preserving them from all apparent deterioration.

The Swedish government was wise;—in 1739 it established an agricultural school—it placed Mr. Alstroemer at the head of it—it offered premiums to the breeders of Spanish sheep, and premiums on the sale of the best wool. The plan succeeded: the importation of foreign fine wools diminished, and the growth of native wool began to exceed in quantity that which was imported. The manufacture of fine cloths increased, and yet the importation of fine wool was lessened. It did not quite cease because some of the German wools, grown at no great distance, could be purchased at

* See Mr. Hubbard's valuable table, p. 101 of the present work.

little price. The Merinos did not supersede the native breed, because the growth of long wool was indispensable for the clothing of the peasantry; and every flock did not prosper, because the Merinos, like other sheep require more attention, both in the breeding and the management, than the Swedish boor was willing to bestow, in order to preserve them in full perfection.

In 1764 there were in Sweden 65,000 sheep of the pure Merino blood, and 23,000 of a breed between the Merinos and the natives, and which bear an improved sort of wool. They gradually increased, and are now supposed to amount to a hundred thousand, or one twenty-fifth part of the whole number of sheep in Sweden.

In general they preserve their original form, and their original fleece; and although they have somewhat increased in size and hardihood, their wool has lost none of its softness or fineness. M. Lasteyrie states that he had the opportunity of comparing a flock of Merinos, established fifty-five years at Upland, with another that had just arrived, and he found that the wool of the old stagers was fully as good as that of the newly imported sheep.

The management of the Merino sheep in Sweden by intelligent agriculturists is suitable to the character of the sheep and the nature of the climate. The system of migration is completely abandoned. Both the native and imported sheep, after having been pastured during the day, are usually housed in the night at all seasons, on account of the great number of wolves. The peasantry and small farmers have these houses too confined and crowded; the better sheep-master has them large and well ventilated. The native Swedish flocks are kept in these buildings when the weather is unusually severe; the Merinos are housed during the six winter months; but the most scrupulous attention is paid to the cleanliness of the place, and scarcely any inclemency of weather will prevent the whole flock being driven out daily, at least for a few minutes, in order to breathe the fresh air while the sheep-house is cleaned. The Merino sheep are seldom used for breeding until they are two and a half years old, and are fattened for the butcher at seven. Great quantities of cheese are made from the milk of the native breeds—but the milk of the Merino is left for the nourishment of the lamb. The flocks are shorn in July—the fleece having been washed two or three days before the shearing.

### THE FRENCH SHEEP.

The breeds of sheep in France are as various as the face of the country and the nature of the pasture of that extensive kingdom; but there are not many of them, except towards the very south of the country, that yield a fleece possessing much intrinsic excellence either for the purposes of the comb or the card.

When the British traveller lands in *Picardy*, and particularly in the neighbourhood of Boulogne, he thinks that he recognizes, in the hornless white faces and general form and appearance of the sheep, those of his native country. He is not altogether mistaken, for he finds a cross between the Romney-marsh sheep, which he has just left, and the sheep of Flanders, on the borders of which he then stands. The wool, however, is shorter and coarser, and more elastic than he has seen it in Kent, and not adapted for the better kind of fabrics. These are, altogether, the largest and finest sheep in France; and in some parts, and especially in the neighbourhood of Beauvais, he will see many to whom the Kentish sheep have imparted the propensity to fatten, which they derived from the Leicesters. The fleece also will probably weigh from six to eight pounds. At Abbeville was a

celebrated manufactory of fine cloth; but the neighbouring country yielded little of the wool employed.

Skirting the western coast he enters *Normandy*, in some parts of which he meets with a large breed of sheep—large for France—and weighing fifteen or sixteen pounds the quarter; but the Norman sheep do not in general average more than fifty pounds the carcass. At Colentin and at Valognes, in the peninsula which terminates in Cherbourg and Cape La Hogue, he finds some exceedingly good long-woolled sheep, and the fleece of which is employed in the lightest and best stuffs. The serge manufactory at Valognes is deservedly celebrated. These sheep form a pleasing contrast with others that he has met with between Rouen and Caen. Most of the Norman sheep are easily recognized by their red legs and faces. Some of the best and the worst mutton that France produces are found in Normandy, namely, at Colentin and Faux.

Still proceeding southward he begins more to recognize the true character of the French sheep, and in *La Maine*, and about Mayenne and Segre, he sees the long leg and thin carcase and coarse fleece of the Gallic long-woolled breed; and he fancies that he perceives more of the dry and insipid taste of the French mutton. In some parts of La Maine, however, the pure Flanders sheep are found; and others that bear comparatively fine wool. Many sheep are likewise fatted here for the Paris market; they are known by the name of the Alençons, the principal markets and fairs for them being in the neighbourhood of Alençon.

As he proceeds along the coast through *Bretagne*, *Poitou*, *Guienne*, and *Gascony*, he will find the character of the sheep essentially changed. He will begin to recognize the smaller short-woolled breed of various qualities, and some of them exceedingly valuable. Many of the true Flanders breed will linger about Poitou preparing for the Paris market: but the short-woolled breed will rapidly increase, and, in many places, occupy the whole of the country. In *Navarre* and *Bearn* he will recognize the neglected sheep of the mountains, with short and fine wool too much mixed and overrun by a coarser species of wool, as the native shepherds say, but, in point of fact, by real kemps. The fleece of a Navarre sheep will sometimes weigh eight or ten pounds; but it is often mostly composed of that which is comparatively valueless.

At the Lower or *Basses Pyrenees* the fleece weighs from three to five pounds, the wool is six or seven inches long, and tolerably fine. From the latter end of November until the spring, these sheep are kept in close houses; but no sooner does the snow begin to melt, and the grass to shoot, than the wethers, the ewes, and the yearlings, are turned out on the mountains. The lambs are kept back for a few weeks in order that they may forget their dams; and then all graze together on the short grass, which is so abundant that they have not occasion to wander far for an ample supply. In the evening the flock is collected into an uncovered fold near to a rude hut, built for the habitation of the shepherds. Little attention is paid to them in the day, and none at night, except the shepherd is roused from his slumbers by the barking of a Pyrenean dog, to whom the charge had been assigned of giving notice of the approach of the wolves or the bears. These sheep, when fat, weigh from ten to fourteen pounds the quarter. The wool generally has a peculiarity of colour: it is beautifully white towards the roots, and becomes of a fawn or red colour towards the extremity of the fibre.

In the central, or High Pyrenees, a different sheep is found. It bears considerable resemblance to the English Norfolks, having their horns and black faces and legs.

Still proceeding to the east, and entering Rousillon, a short and fine-

woolled sheep is found not unlike and scarcely inferior to the Merino. This breed is descended from the Merinos, a considerable depôt of which is established at Perpignan. The chief difference between the Rousillon and Merino sheep is that the wool does not grow so close; it does not present the same firm compact appearance, but hangs on the animal in separate and detached locks. The spiral structure, however, of these locks is beautiful; and the curves extend from the point to the root. The tint of the fleece is here more of a fawn or yellow colour, and the yolk is as abundant as in the Merino.

Pursuing the line of coast by Perpignan into Languedoc, the fine-woolled sheep continue to present themselves, and the fleece grown about Bezieres is highly esteemed. If there is an objection to these sheep, and one that increases when they are crossed with the Merino, it is that they do not fatten kindly. The fleece is susceptible of much improvement; the original coarse Bearn coat acquires considerable fineness and value; but the gaunt appearance and unthriftiness of the Merino is too much imparted.

Passing by the beautiful country of Montpelier and the mouths of the Rhone, the traveller can study the fine sheep and the sheep-husbandry of Arles. The district of the Crau, in length nearly eighteen miles, and about half as much in breadth, extends from the mountains towards the sea-coast. It is one uniform gentle declivity; in no part of it is there the slightest portion of stagnant water, and not a tree or a bush is to be seen. The soil is consequently dry, and apparently barren enough; but the herbage which it affords is that which peculiarly suits the sheep, and the cock's-foot grass, and the clover (*trifolium pratense*), and the common thyme, and the wild thyme, and the lavender (*lavandula spica*), grow amid the flints, affording a pasture nutritive, without one dangerous aqueous property, and of a luxuriance that would scarcely be deemed possible. No less than 130,000 sheep graze on this declivity.

A writer in the Memoirs of the Royal Academy of Sciences at Paris attributes the thriving of the sheep on such a spot to the free use of salt, thereby enabling the digestive organs to extract every particle of nutriment which the food contains. He says, "on this spot, so seemingly sterile, by the free use of salt, more numerous flocks of sheep are bred and reared than upon any other common of equal extent throughout the whole kingdom; and, what is not less remarkable, the sheep are healthier, hardier, and endure the severity of the winter with less loss, though they have fewer sheep-cots for covering, than those fed and bred on more copious pastures, and that have, besides, the advantage of more convenient shelter. It frequently happens that the Crau is so burnt up in the summer, that the poor animals," those at least that remain there, "are forced to turn up the very stones to come at the few blades of grass which grow around them, and yet none perish for want of food." Much advantage is doubtless derived from the salt; but the pasture is not quite so bare as this writer represents, and it is of that kind on which sheep everywhere flourish*. To this may be added, that the sheep on the Crau are, like those of the district next to be described, in a great measure *transhumantes*.

The Camarque, and Le Plain du Bourg, are two other districts of Arles abounding in sheep. They produce nearly the same herbage, with the exception of some of the aromatics; but instead of these there are the shrubby saltwort, the glass-wort, and the small shrubby orache—saline plants which always contribute to the health of the flock. About 112,000 sheep are pastured during the winter in these districts. They are a

* Quarterly Journ. of Agricul. vol. ii. p. 591. Annales de l'Agricult. Franç. 3e ser. tom. xiii. f. 219.

little larger than those of the Crau, but the wool is very nearly as fine. The superiority of the Crau wool has been accounted for in a singular yet not improbable manner. By reason of the numerous loose stones on the plain of Crau, the teeth of the sheep are frequently broken to so great an extent that the animals are usually slaughtered at or before five years old, and there is no defective wool from old worn-out sheep, but the produce of the adult and healthy alone is brought to the market.

All these sheep are migratory. In the spring of the year they are driven from the plains of Arles and the Delta of the Rhone towards the Alps, which divide Provence and Dauphiné from Italy. They mostly direct their course towards the hills in the neighbourhood of Barcelonette and Gap. The migration commences in May, and the sheep return to their winter quarters in November. These sheep are the property of the agriculturists of Arles and the neighbouring districts; and the migration is not only sanctioned by custom from time immemorial, but by particular laws which give them, and limit them to, a road thirty-six feet in breadth.

The flocks from the various districts of Arles, and the southern part of Provence, are collected together, and driven in troops of from 10 to 40,000 sheep. To every 1000 sheep three shepherds are allowed, each of whom has his dog, and in the centre of the flock is a troop of asses carrying the provisions and baggage. One shepherd is chosen by his fellows to direct the march, the expenses of which are defrayed from a common purse, of which he is the bearer. He travels in the centre, and thence transmits his orders, and issues the daily allowance of provisions, and listens to and determines on the complaints of the farmers in the neighbourhood of the road if any damage has been accidentally or wilfully done, and punishes the shepherds for any offence committed.

The sheep are led by goats which are trained for the purpose, and have bells around their necks. The discipline in which these animals are kept, and the intelligence which they display, is very great. They halt or proceed at the direction of the shepherd; they come to the centre at the close of each day's march, and there wait in the morning for the proper order, when they repair to their station at the head of the troop with the greatest regularity. If they come to a stream they halt until the word of command is given; and then they plunge immediately into the water, and are followed by the rest of the flock. The journey usually lasts from twenty to thirty days. When they arrive at the mountains each shepherd has his appointed boundary marked out; and the proprietors of the land are usually paid about twenty sous per sheep for their pasture during the summer. The shepherds sleep with their flock in the open air, and live almost entirely on bread and goat's milk *.

The question of the influence of these peregrinations on the fleece has been already considered. They occupy little more than half the time consumed by the Spanish sheep, and much of the objection to the system is therefore removed; but the fact is, (whether to be accounted for on the ground of prejudice, or the actually increased value of the sheep,) that the wool of the transhumantes sheep always sells for a greater price than that of the estantes. To this should be added the improvement of the sheep in the neighbourhood of these periodical resting places. The flocks of Gap and Barcelonette are much more highly esteemed than those only of a few leagues farther to the north, because they descended originally from the sheep of Arles, and are recruited every year by the migratory troops from that district.

* Annales de l'Agric. Fran., ibid. f. 220. See also the Encyclopædia Londinensis, article, Wool.

The reader must now be supposed to return very rapidly through the central districts of France. The fine-woolled breeds of the southern provinces have their influence on the sheep for a considerable distance northward; and almost the whole of the wool is in much repute. In Dauphiné it is yet finer than in most of the central southern provinces. The effect of a cross with the Merinos is sufficiently evident, but, at length, the breed of sheep, cultivated principally or almost entirely for wool, then begins to disappear, and a larger, coarser, but, on the whole, not less profitable animal is substituted. Both breeds are found in Burgundy. In Auvergne is a mountain breed, with black and white heads, and little esteemed. In Berri there is a considerable portion of fine wool, but many of the sheep are fattened for the Paris market, and the wool is consequently deteriorated. In Champagne the wool, although long, is tolerably fine, until the traveller arrives at the neighbourhood of Rheims and the commencement of the forest of Ardennes, where the sheep are small and the fleece coarse. Lorraine is almost exclusively a grazing country, the principal part of the sheep being bought in Alsace, or in the German markets.

The number of sheep in the whole of France was calculated in 1825 to be more than thirty millions; but a considerable diminution has taken place since that period. The year 1829 was almost as destructive to the French sheep as to those in England. One proprietor at Arles lost four thousand during that winter. The division of property—the separation of a large farm among several proprietors—has tended still more to lessen the number of sheep. It is the occupier of an extensive demesne alone who is able to adopt that system of agriculture that will enable him to provide for a numerous flock. Supposing a farm to be shared among four proprietors, the aggregate of the sheep kept by the four will not usually exceed half the number which the former occupant had possessed. In some of the departments, where this division has been carried to a great extent, not one-fourth part of the sheep that grazed there before the Revolution are now kept. The change which has taken place in other departments is not so considerable, but it may be fairly concluded that the number of sheep has, with the last ten years, decreased at least one-sixth part. Paris consumes about 347,000 sheep and lambs annually, being but little more than $\frac{1}{87}$th part of the existing flock*.

A short account of the supply of the Paris market will give the reader a sufficient idea of the grazing districts in the central and northern parts of France; the south is more devoted to the growth of fine wool. The first sheep that arrive at Paris after the expiration of Lent are from Flanders and Artois, and they continue until the end of May. The principal supply is from Brabant in May and June. Sheep also come from Maine and La Perche, from the end of May to October. The Alençon sheep, and those from Bourbonnois and Poitou, occupy the market at the same time. Sheep in good condition arrive from Berri in June, and continue until the end of October; and from Hainault and Normandy in great numbers towards the end of July, and in decreasing numbers to the end of October. From the forest of Ardennes they are sent from July to December; from Touraine, Gravelines, Liege, Brabant, Compigne, and occasionally from Swabia, during the whole of the autumn, through the medium of a company established in Switzerland. The Beauceron sheep that have grazed in Brie, Hurepoix, and Beauce, principally furnish the capital with mutton from the

* It will hereafter appear that $\frac{1}{22}$ part of the existing flock is annually consumed in the British metropolis, but the far greater comparative population of London, and the different consumption of animal food by the inhabitants of the two countries, will satisfactorily account for this.

latter part of the autumn to the middle of the winter: and from January to Lent the Picardy and Santerre sheep are killed, and those that are fattened in the neighbourhood of Beauvais.

In addition to these the graziers of Lorraine go to Germany and buy lean sheep at Aix, Hanover, Paterbonne, Veterave, and Valdeck, which they fatten for the Paris markets. Burgundy also sends a few sheep from time to time, and likewise small flocks come from Hainault and Artois, independent of those that are sent in July. Paris draws one-third of its supply of sheep from the country within thirty miles around it; one-third from the Ardennes, Alsace, Lorraine, and the German states to which the graziers of Lorraine travel, and the remaining one-third from the districts already mentioned.

All these animals come to the markets of Sceaux or Poissy, where they pay a toll, and no sheep must be bought by the butchers without a passport from these places.

It would naturally be expected, that, divided from Spain by the Pyrenees alone, France would be the first to avail herself of the advantage of improving her flocks by crossing them with the Merinos. In the early part of the eighteenth century a project of this nature was entertained by the illustrious statesman Colbert. At his own expense several Merinos were brought across the mountains; but his plan met with the opposition which attends every new undertaking, and was abandoned, leaving no trace of improvement behind.

Thirty years afterwards M. de Perce imported a little flock of Merino sheep, and he crossed some of the indigenous breeds with this foreign race. The experiments were attended with so much success, that the public attention was awakened to the subject. M. Trudaine, the intendant of finance, was most earnest in his wish to ameliorate the French fleece, and to render his country as much as possible independent of the neighbouring states for the material of the woollen manufacture. He consulted with M. Daubenton, who had written one of the earliest, and still one of the best works on the general management and diseases of the sheep. The result was that in 1776 rams and ewes were procured from Roussillon, a breed that has just been described as one of the best in France, and approaching the nearest to the Merinos, and other sheep from Flanders, England, Barbary, Thibet, and Spain. These animals were placed on a farm near Bourgogne, in a district somewhat mountainous, and therefore favourable to the production of fine wool, the grand object of the experiments to be made.

M. Daubenton experimented on these sheep during seven years. He kept some of all the breeds perfectly pure, and he mingled others in every possible way. The result was that he was enabled to produce from every breed, properly crossed, a wool equal to that from the best Spanish sheep.

This conclusion was unexpected, and, as it afterwards seemed to appear, either was not founded on a sufficient number of accurate experiments, or required more care and attention than sheep-masters generally would or could bestow, in order to secure the continuation of such a result. One thing however was beyond contradiction,—that the Spanish sheep in other countries, and under modes of management different from those to which they had been accustomed in their native clime, would retain every valuable quality for which they are so justly celebrated.

On this the French government acted; and in 1786, 376 ewes and lambs were purchased in Spain, and sent to Rambouillet, in the neighbourhood of Paris, where was an agricultural establishment expressly devoted to the improvement of the domesticated animals. Sixty of them died on

their passage. Thirty-five ewes, and sixty lambs, were afterwards destroyed by the *claveau*, a disease of the skin—a kind of sheep-pox, fortunately, almost unknown in Great Britain.

The Rambouillet flock gradually increased, and a few were given to those agriculturists who appeared to be disposed to bestow sufficient care on their cultivation. This was an ill-advised measure. That which could be had as a gift was deemed to possess little value; and the new breed had not justice done to it. It was then determined than an annual sale of a portion of the stock should take place. The first sale was in 1796, ten years after their establishment at Rambouillet. The average weight of the fleece in the yolk was then 6 lbs. 9 oz.; the average price of the fleece 5 francs—the average price of the sheep, 71 francs for a ram, and 107 francs for a ewe, and the highest price at which a single sheep sold was 200 francs. Five years afterwards the flock had so much improved in public estimation, and in real value, that the average weight of the fleece was 9 lbs.—its price 28 francs; the average price of the ram 412 francs, that of the ewes 236 francs, and the highest price of any of the sheep 630 francs.

The most rigorous examination was instituted; and the superfine wools obtained in France from the pure breed, were worked into cloths in every respect as good as those from the *refina* or *prima* wool of the best breeds in Spain. The wool produced from the mixed breed, after the fourth or fifth cross, when made into cloth, was equal to that manufactured from superfine Spanish wool.

In order to perfect the undertaking, a publication on the treatment of sheep was drawn up by M. Gilbert, under the patronage of government; a practical school for shepherds was instituted at Rambouillet, and two other depôts for Merino sheep were established, one at Pompadour in the department of the Corrèse, and another at Perpignan in Rousillon, at the foot of the Pyrenees *.

These statements would seem to be highly encouraging;—but so systematically had the sheep been neglected in France, and so inveterate were the prejudices of agriculturists generally, that when an account was taken of the number of sheep in 1811, five-and-twenty years after the establishment of the flock at Rambouillet, there were thirty millions of the native breeds, and only two hundred thousand pure Merinos.

At the sale of Merinos at Rambouillet in 1834, the average price of the ram was 328 francs, and the greatest sum given for the best 510 francs. The average price of the ewe had sunk to 108 francs, and the highest price of the best was only 210 francs.

It may therefore be concluded that the Merino sheep and the Merino wool will never be extensively cultivated in France. In fact, from the character of the French wools generally—long and coarse,—a different

* The following is Mr. Trimmer's account of the Rambouillet flock which he visited in 1827. It was evidently written under the influence of much prejudice:—"The sheep in size are certainly the largest pure Merinos I have ever seen. The wool is of various qualities, many sheep carrying very fine fleeces, others middling, and some rather indifferent; but the whole is much improved from the quality of the original Spanish Merinos. In carcase and appearance I hesitate not to say, they are the most unsightly flock of the kind I ever met with. The Spaniards entertained an opinion, that a looseness of skin under the throat, and on other parts, contributed to the increase of fleece. This system the French have so much enlarged on, that they have produced in this flock individuals with dewlaps almost down to the knees, and folds of skin on the neck, like frills, covering nearly the head. Several of these animals seem to possess pelts of such looseness and size, that one skin would nearly hold the carcases of two such sheep. The pelts are particularly thick, which is unusual in the Merino sheep. The rams' fleeces were stated at 14, and the ewes' 10 lbs. in the grease. By washing they would be reduced half, thus giving 7 and 5 lbs. each."—Trimmer's Practical Observations, p. 45.

kind of improvement,—a different kind of wool is necessary, in order to perfect the manufacture of serges and stuffs, and bombazines in that country, and—the principal object of all—to enable the native wool of France to be used to any considerable extent in the preparation of these goods. It is singular that this point of paramount importance to the woollen trade of France should have been so long overlooked. It is to be traced to that mutual jealousy and alienation which have much too long existed between France and England.

A long breathing-time of peace has enabled the French woollen manufactories to revive, and with this the demand for foreign wool, and wool which Britain alone could supply. In the year 1833, no fewer than 1,424,208 lbs. of long wool were imported from England. The French government was alarmed at this increasing demand for a foreign material; and in October, 1833, sent a competent person to England, to inquire into the character and mode of treatment of the British long-woolled sheep, and to purchase a flock by means of which either a pure breed—(the improved Leicesters were wisely chosen)—might be established in France, or the native breed materially improved.

A considerable number of the Leicesters were in that year imported into France; but whether it was that the management of them had not been sufficiently studied, or that they had been placed on pastures that were not suitable to them, the greater partdied in a very short time, and then, as the reporter on this subject to the Royal and Central Board of Agriculture at Paris, the Viscomte Debonnaire de Gif, very naïvely remarks, speaking of his countrymen,—" As it is our character to seize with avidity on new ideas, and quickly to abandon them when unexpected obstacles arise, the hope of naturalizing in France the long-woolled sheep of England completely vanished." A few steady agriculturists, however, had continued to cultivate them, and not only the unmixed breed retained all its primitive excellence, but the French breeds that had been crossed by them yielded a longer, a sounder, and yet a finer fleece; and the size of the animal and the quality of the flesh were considerably improved. One of these gentlemen, M. Duverger, residing near Varsailles, had retained a flock of more than 200 pure Leicesters.

The demand for British wool continuing to increase, a commission was appointed to examine these sheep. The report was most favourable, and the director of the school of Alfort, M. Yvart, was dispatched to England, in order to procure a new importation, and, if possible, of more valuable sheep. He arrived in Leicestershire in October 1833,—he selected 110 ewes and 12 rams of the Bakewellian breed—and under his superintendence they were disembarked at Havre, and arrived at Alfort without the loss of a single sheep; and in the succeeding five months they lost only two sheep, and these from " the blood "—inflammatory fever.*

On the 25th of March, 1835, the same nobleman made a second report on the state of this flock. It had been transported to a farm at Maison Alfort, on the road to Melun, and after having been in France two winters and a summer, had increased to nearly 300. Many of the first lambs were two-thirds grown, and promised well, and the flock generally seemed to be in perfect health. The losses had been at the rate of 11 in 100, and had principally arisen from *red water*, which had appeared as an epizootic in the neighbourhood of Alfort, and had destroyed a great many sheep of all breeds. The Leicesters had become habituated to the French shepherds and dogs—they retained their natural quiet habits, wandering far less over the pastures

* See a very interesting report of this proceeding, Annales de l'Agriculture Fran., third series, tom. xiii. f. 261.

than the French or Merino sheep,—they were likewise less difficult in the choice of their food than either of the others, and evidently fattened more quickly than them. It was obvious, however, that they could not be driven so far or so fast to pasture as either of the others.

They had been shorn in the preceding summer, and their fleece had not suffered the slightest deterioration either in length, soundness, or lustre. Five lambs between 11 and 12 months old had been slaughtered, weighing when alive 481 lbs. or 96 lbs. each, and yielding in carcass 231 lbs., suet 24 pounds, and wool 47 lbs. Five wethers between 24 and 25 months old weighed, when living, 604 lbs., or nearly 121 lbs. each, and yielded in carcass 326 lbs., suet 36 lbs., and wool 40lbs.: the meat was of the finest quality, and attracted general observation.

Several of the young ewes have been parted with to the neighbouring farmers,—some of the rams have been let at the average of 50 franks each, and it is the intention of government to have an annual sale and letting. "We think," concludes the reporter, "that the question of the naturalization of the English long-woolled sheep in France is now determined in the affirmative—that without neglecting the cultivation of the Merinos, which during the last forty years have done so much for France, there is another breed equally worthy of care—and that the Leicesters, placed as now, where before there were only ordinary sheep, and where a good supply of food may be constantly calculated on, will yield to the breeder by their wool, and yet more by their flesh, a recompense fully equal to that which the Merinos would give, and will exercise a happy influence on the prosperity and agricultural and manufacturing industry of France*."

No apology is made for the length of these extracts, but the reader and the author of the present treatise will equally unite in wishing that the predictions of the commission may be fully accomplished.

There is nothing peculiar in the French management either of the Merino or Leicester sheep.

### THE NORWEGIAN SHEEP.

Next in order of time stands Norway. The Norwegian sheep do not differ much from those of Sweden. The legs are long—the carcass has likewise an appearance of length and unthriftiness, and the wool is coarse and moderately long. One of their earliest natural historians says that some English sheep were imported as a stationary breed, and with a view to the improvement of the native ewes; but they speedily degenerated, and after the third or fourth generation were hardly superior to the natives†. He also relates that in the islands on the coast of Norway there are many wild sheep, that are never housed or taken care of, but are annually caught to be shorn. Later travellers speak of the same breed as existing in a wild state amidst the snows without receiving attention or food from man, and so untamed and untractable that they cannot be taken unless they are fairly hunted down by a person on horseback. Efforts have been made to reclaim and domesticate them, but they have rarely survived the first year of their confinement. They appear to belong to the primitive fat-rumped breed, for Pontoppidan affirms that "their fat is found in their external parts, and covers their flesh like a warm cushion." The same author likewise asserts, which seems singular in so cold a climate, that "when in summer they are turned out upon the mountains they are so exceedingly tormented with the heat, and with gnats and musquitoes, that they run about regardless of danger, and in this frenzy many have lost their lives, falling

* Annales de l'Agricul. Fran., third series, tom. xv. f. 282.

† Pontoppidan's Natural History of Norway, Part II. p. 6.

down the precipices; on this account the peasants build rude huts for them, into which they may retreat from their tormentors *."

A partial improvement is said to have been effected in the Norwegian sheep by a Spanish ram that was wrecked about the middle of the last century on the western coast. The sheep in the neighbourhood of Smaalchaem produce better wool than in many other parts of Norway. A few of their fleeces have weighed six or seven pounds. That which has probably tended much to render the Norwegian sheep more deteriorated than even cold and starvation could effect, is the custom of frequent shearing. Lasteyrie says that they are shorn twice, thrice, and even four times in the course of a year. He is probably mistaken in this assertion; for such a practice must be so decidedly injurious both to the sheep and the fleece, that it could not be tolerated for the shortest period of time. The rapid growth of wool immediately after shearing is in all sheep accompanied by a slight degree of fever and debility, and the recurrence of this several times in the year must tend to weaken the animal and interfere materially with his condition. It may be further remarked, that although there may be somewhat greater weight of wool from the two shearings than from the one, on account of this rapid growth of the wool after the top covering is removed, yet it is a coarse kind of wool that is thus produced; it is hard and large for the temporary defence of the denuded skin, and the finer and more valuable part of the wool is always found near the root, sheltered from the influence of the sun and air†.

### THE DANISH SHEEP.

These are, in many respects, not unlike the sheep of Sweden and Norway. The head is long and thin, the neck arched, the eyes small, the countenance wild, the legs and tail without wool. In some parts of Holstein they are without horns, and, like a few of the wilder kinds of sheep already described, they have two appendages of skin hanging from the upper part of the throat. They are of moderate size, and their wool of a medium length, and which may be used either for the card or comb. It is shorn only once in the year. These sheep are rarely or never housed.

In the Duchy of Holstein, quite on the southern part of Denmark, is a peculiar and valuable breed of sheep, and bearing considerable analogy to some of the primitive ones. They are of a moderate size, polled, yielding fine wool, but not in great quantity: the tail is broad and fat to a very considerable degree towards the root, and gradually diminishes in size and terminates almost in a point. A bell-wether here, as in Spain, answers the purpose of a dog for the guidance of the sheep, or, should a sheep, more discontented than his fellows, show a disposition to wander, he is coupled for a few days with one of a quieter character.

About the year 1780, the Danes began seriously to think of ameliorating their native breed by the introduction of the Merinos; a few of them were therefore imported, but from some neglect or mismanagement they evidently and very soon deteriorated. In the hands of some agriculturists they supported the reputation of their breed; but the few that were properly cultivated made little or no impression on the general character of the Danish sheep.

In 1797, the government wisely determined to operate on a larger scale. A flock of 300 Merino sheep, composed of some of the best breeds of the Leonese Transhumantes, was procured and located on a farm at Esserum, about twenty miles from Copenhagen. They were carefully and skilfully

* Pontoppidan's Natural History of Norway, Part I. p. 32.
† Lasteyrie, p. 148.

managed, and although they have not superseded the native breeds, nor in every province effected much change in them, yet they have in many places improved the general character of the sheep and wool, and enabled the Danes to export from Copenhagen alone more than 800,000 lbs. of wool, nearly half of which, and of the finest quality, reaches the English market.

### THE SHEEP OF THE FEROE ISLANDS.

These islands, situated in the Northern Atlantic Ocean, and to the N. W. of the Shetland Islands, and between them and Iceland, contain much fine pasture for sheep, and a small and wild breed of these animals. Mr. Wilson observes, that Dicuil, who wrote in the year 825, describes these islands of Feroe as being covered with innumerable flocks. Landt says, that the principal island contains a great number of small sheep, which are black, with short curled wool, their flesh having a peculiarly dark appearance, and in taste approaching near to that of other wild animals. Mr. Wilson adds, that Mr. Trevelyan visited the Feroe islands in 1821, and found the remnants of the wild race in no way dependent on, or under the control of man. They are sometimes caught by dogs, but can seldom be obtained except by being shot, or intercepted in a narrow space and driven over the cliffs. The wool was remarkably short, and, in the opinion of this gentleman, the flesh, though lean, was palatable *.

### THE ICELAND SHEEP.

The sheep of this frozen climate are of two kinds; a small, and probably the native breed, in colour varying from dun to almost black, and a larger white breed, probably imported from a more southerly region. The coat is that which nature would give to the inhabitants of such a clime. It consists of long coarse hair externally, and a close layer of wool within, which no wet or cold can penetrate. This wool, however, when freed from the hair, is of little value for manufacturing purposes, and is fit only for horse and collar cloths, and common rugs and blankets. Many of the last are exported to North America.

Even in so cold a country they are rarely sheltered from the winter's storm, nor is any provision made for the winter's food. Their only refuge is the jutting rock, or the mountain cavern. In their haste to reach these places, when overtaken by a storm, and the snow driving against them and confusing their vision, many are precipitated down the cliffs, and drowned in the sea beneath. If they are surprised by a snow-storm before they can reach the coast, they turn their heads towards each other, and huddle together in a round close body, the united heat of which raises a dense vapour that penetrates through the snow, and directs the shepherd to the place where his flock is buried, although not always until the sheep are nearly starved, and have begun to feed on each other's wool in order to preserve life†. Livingston adds, that in the cold nights, without snow, "and when the bleak wind pinches them, they keep each other warm by pressing close together; and those in the centre relieve in turn those who in the outer part of the circle are exposed to the greater severity of the blast: thus, necessity

* Quarterly Journal of Agriculture, vol. ii. p. 542.

† Kerguelin affirms, that when the sheep have once been driven to this sad extremity, they will afterwards, even on the most plentiful food that Iceland affords, frequently nibble and tear the fleece of their companions. The habit becomes so inveterate, and the appetite for this strange nutriment so strong, that it seems a kind of mania, and the farmer is compelled to destroy these sheep.—Voyage to the North. Anderson seems to entertain a similar opinion.

sharpens the inventions of beasts as well as of men*." The only kindness which these animals receive from their keepers in the winter is, being fed on fish bones, or frozen offal, when their natural food is buried too deep even for their ingenuity and patience to reach it. Yet they repay all this neglect with a supply of wool, of which mention has just been made, and which to the Icelander is valuable; and also a quantity of milk, far superior to that which is yielded by any southern flock. If Von Troil is to be believed, an Iceland ewe will yield from two to six quarts a day†.

The principal peculiarity about these sheep is the number of their horns, the greater part both of the small and the large breed having more than two, and a few of them carrying eight horns. They commonly have three or four, or five, most of them of a spiral form, yet often but little developed; the side horns are curved in various directions. This cut contains a portrait of one with three horns.

[*Iceland Sheep.*]

When the horns do not exceed five they are placed in one row, and all of them springing from the frontal bone, on which, as in the sheep of Cyprus, there is a high and strong ridge, in order to form a proper basis for the horns. When there are more than five horns they are placed in two rows; but still they are prolongations of the frontal bone and of that alone. This invariable position of the base of the horns will be more fully illustrated when the skeleton of the sheep is described. It is worthy of remark, that while the sheep of Iceland are, with very few exceptions, many-horned, the cattle are polled.

### THE AZORES SHEEP.

Before the reader returns to the continent it may be stated that the sheep of the Azores islands, in the Atlantic, off the coast of Portugal, and nearly in the same latitude with Lisbon, contain numerous flocks of sheep, many of them nearly or quite wild. They are cultivated for their

* Livingston on Sheep, p. 19. Quarterly Journal of Agriculture, v. ii. p. 541.
† Von Troil's Letters on Iceland, p. 133.

wool alone, which is manufactured into a coarse species of cloth for the consumption of the inhabitants. Their flesh is rarely eaten. The miserable and arbitrary policy which prevails in these islands, the system of short leases, and the absence of practicable roads, sufficiently account for the wretched state of sheep-husbandry, and of agriculture generally*.

### THE SAXON SHEEP.

The Elector of Saxony ranks among the first who patriotically and wisely devoted himself to the improvement of the inferior breed of sheep which pastured on the neglected plains of Germany. The indigenous Saxon breed resembled that of the neighbouring states: it consisted of two distinct varieties, one bearing a wool of some value, and the other yielding a fleece applicable only to the coarsest manufactures.

In 1765, at the close of the Seven Years' war, the Elector imported one hundred rams and two hundred ewes from the most improved Spanish flocks, and placed a part of them on one of his own farms in the neighbourhood of Dresden; this portion he kept unmixed. He endeavoured to ascertain how far the pure Spanish breed could be naturalized in Saxony. The other part of the flock was distributed on other farms, and devoted to the improvement of the Saxon sheep.

It was soon sufficiently evident to the enlightened agriculturist, that the Merinos did not degenerate in Saxony; many parcels of their wool were not inferior to the choicest fleeces of Leon. The best breed of the native Saxons was also materially improved. The prejudice against every innovation on the practice of their ancestors was, however, as strong in Saxony as elsewhere, and the majority of the sheep-masters were still averse to the improvement; but the Elector was determined to accomplish his object: he imported an additional number of the Spanish sheep, and then, adopting a measure unworthy of such a cause, he compelled those who occupied land under him to buy a certain number of the Merino sheep.

It was not necessary long to pursue this compulsory system: the most prejudiced were soon brought to perceive their true interest. The pure Merino breed rapidly increased in Saxony; it became perfectly naturalized; nay, after a considerable lapse of years the fleece of the Saxon sheep began not only to equal the Spanish, but to exceed it in fineness and in manufacturing value.

By referring to page 155, it will be seen that a sample of picklock Merino wool was $\frac{1}{750}$ths of an inch in diameter, and exhibited 2560 serrations in the space of an inch; while the Saxon wool (see page 89) was only $\frac{1}{840}$th of an inch in diameter, and presented 2720 serrations of an inch. Corresponding with this, and most satisfactorily illustrative of the account which has been given of the structure of the fibre of wool and its felting property, and manufacturing value as dependent on that structure, the price—the true test of value—of the best Leonese Spanish wool in 1834, varied from 2*s.* 6*d.* to 4*s.*, while that of the Saxon wool was from 4*s.* 9*d.* to 5*s.* 3*d.* per lb.

The government of Saxony very materially contributed to this result by the establishment of an agricultural school, and other minor schools for shepherds, and by distributing certain publications which plainly and intelligibly explained the value and proper management of the Merino sheep. The government of a country may fail to accomplish many capricious or tyrannical objects, but it will receive its best reward in the full accomplishment of its purpose, when it thus identifies itself with the best interests of its subjects.

* Boyd's Azores, p. 42.

[*Saxon Merino Ram.*]

The above is a portrait of a Saxon Merino ram, the property of Lord Western, and used by him extensively and beneficially in the improvement of his Spanish Merinos. It will be seen that his frame differs materially from the Spanish Merino: there is more roundness of carcase and fineness of bone, and that general form and appearance which indicate a disposition to fatten, and are tolerably certain pledges that the carcase will not be entirely sacrificed to the fleece *.

In Saxony, as in Silesia, although the sheep are housed at the beginning of winter, yet they are turned out and compelled to seek, perhaps under the snow, a portion of their food whenever the weather will permit; and the season must be unusually inclement in which they are not driven into the courts at least for two or three hours during the middle of the day. The doors and the windows also are frequently opened, that the sheep-houses may be sufficiently ventilated. Some sheep-masters, whose convenience is promoted by such a system, keep their flock in the house or the yard during the whole of the year, and it is not believed that the sheep suffer from this either in their health, or in the fineness of their fleece. A great quantity of salt is usually given to the Saxon sheep, and principally during the summer, either in their drink or sprinkled among the fodder.

Very great care is taken by the Saxon sheepmaster in the selection of the lambs which are destined to be saved in order to keep up the flock: there is no part of the globe in which such unremitting attention is paid to the flock. Mr. Charles Howard, in a letter with which he favoured the author, says, that "when the lambs are weaned, each in his turn is placed upon a table that his wool and form may be minutely observed. The finest are selected for breeding and receive a *first* mark. When they are one year old, and prior to shearing them, another close examination

* It has, however, been strangely asserted by Mr. Trimmer, that while by the *constant* "confinement of the sheep in winter in houses the wool has become delicate, the sheep have degenerated into a puny, weak race, producing only half the weight of wool and mutton which the parent Merino stock from which they sprung yielded!"—See Trimmer's Practical Observations, p. 3.

of those previously marked takes place: those in which no defect can be found receive a *second* mark, and the rest are condemned. A few months afterwards a third and last scrutiny is made; the prime rams and ewes receive a *third* and final mark, but the slightest blemish is sufficient to cause the rejection of the animal. Each breeder of note has a seal or mark secured to the neck of his sheep, to detach or forge which is considered a high crime, and punished severely."

### THE PRUSSIAN SHEEP.

In most of the states of Prussia, the wool about the middle of the 18th century was of a very inferior quality, and used only in the manufacture of coarse goods; indeed, the soil was naturally barren, and a great part of the land either lay waste, or was covered with water. A few of the Prussian agriculturists believed that their country was capable of material improvement, and struggled hard, and with variable success, in order to ameliorate it. Among the foremost was M. Fink, near Halle, in the Duchy of Magdeburgh. The sheep in his neighbourhood were even inferior to the usual breeds: their wool was coarse and not abundant; it was suited only for the most common and low-priced goods; and the carcase was far from being profitable.

He first looked anxiously for the means of improvement among the breeds of the neighbouring provinces. In 1756 he introduced into Magdeburgh the Silesian breed, which had long been celebrated for the comparative fineness of its wool. The Merinos soon afterwards began to be established in Germany, and the advantageous change which they had effected in the character of the sheep wherever they had been introduced, could not be disputed. Notwithstanding this, M. Fink was unwilling to give up altogether the breeds of Germany, and in 1768 he purchased some Saxo-Merino sheep; his flock was materially improved, but still his object did not seem to be perfectly accomplished, and in 1778 he imported some pure Merinos from Spain. He took as the guide of all his experiments that which is now received as an axiom among breeders, that the fineness of the fleece, and, to a great degree, the value of the carcase too, are far more attributable to the inherent quality of the animal than to any influence of climate or of soil. Uniformly acting on this fundamental principle, and being most particular in the selection of the animals from which he bred, he improved his own native flocks to a considerable extent, and he succeeded to a degree which he had not dared to anticipate, in naturalizing a still more valuable race of animals.

His zeal and his success attracted the attention of the Prussian Government, which at this time had begun to turn its attention to the cultivation of agriculture generally, and particularly the amelioration of the fleece. Frederick II. in 1786 imported one hundred rams and two hundred ewes from Spain; but, illustrative of the difference in result when an organized plan is conducted by one acquainted with all its details, and whose heart is in the affair, and when it is committed to those who know and care little about it, the greater part of the sheep that were distributed in the neighbourhood of Berlin perished by various diseases; those that were sent to distant farms in the country degenerated, and the advantage was far from commensurate with the expense.

The monarch, however, had in M. Fink a proof of the possibility of perfect success, and he persevered: other sheep were introduced. M. Fink was commissioned by the Government to purchase a flock of one thousand of the choicest Merinos; agricultural schools were established, and at the head of one of them was placed the most competent of all persons—the first improver of the Prussian sheep.

As a proof of the increased value of the Prussian breed, M. Lasteyrie, who had an opportunity of examining the flocks of M. Fink, says, that "the sheep are less than the Merinos found in Spain, but are by no means inferior to them in perfections of fleece. Before the improvements had taken place the native breeds produced wool that sold from 11 to 18 dollars per quintal of 100 lbs., (from 5*d.* to 8*d.* per lb.) but now, improved by the use of Spanish rams, it sells from 60 to 85 dollars per quintal," or from 2*s.* to more than 3*s.* per lb. *

The most ingenious and the most experienced men are liable to some inconsistencies; and M. Fink stoutly maintained two principles, which further experience in the breeding and management of the sheep has caused to be abandoned: first, that "food of a good quality, be its nature what it may, does not alter the fineness of the fleece, but merely causes an augmentation or diminution of weight in proportion to its abundance or succulence, and the reverse." The change in the character of the British wool since the introduction of turnip-husbandry and increased attention to the weight of the carcase, affords an unanswerable refutation of this opinion.

He also asserted, that "breeding in and in will not produce the slightest degeneration;" and yet, as if conscious that he was wrong, he changed his rams every third year if he could meet with animals that carried a finer wool, or even as fine as that already produced in his own flock. The influence of the system of breeding *in and in*, as it regards the sheep, will receive due consideration in the proper place.

A brief sketch of his system of management may not be unacceptable to the reader.

He properly maintains, that free exposure to the air is favourable to the quality of the wool, and therefore, although the sheep are housed at the beginning of November, yet whenever it freezes, and the ground is hard, even although it may be covered with snow, the sheep are driven to the wheat and rye fields, where they meet with a kind of pasturage exceedingly wholesome, and while they feed there they are likewise benefiting the crop. Nothing is more common than to see a flock of valuable sheep scratching away the snow with their feet in order to arrive at the short wheat or rye beneath. When the weather will not permit their being taken out, they are fed on hay, aftermath and chopped straw of various kinds. The kind of straw is changed as often as possible, and wheat, barley, and oat-straw and pease-haulm follow each other in rapid succession. The oat-straw is sparingly given, and the pease-haulm is preferred to the wheat and barley straw. Oil-cake, at the rate of six or seven pounds per hundred sheep, and dissolved in water, is also allowed when the flock cannot be turned on the young wheat.

Three or four weeks before lambing, an additional allowance of hay and straw is given to the ewes; and while they are suckling, a little oatmeal is mixed with the solution of oil-cake. When the weather will permit the turning out of the ewes, the lambs are still kept in the houses, and the mothers brought back to them at noon and night; after that, the lambs are not permitted to graze with the ewes, but are turned on the fallows or the clover of the preceding year; for it is supposed that they unnecessarily fatigue themselves by running with their mothers, and almost incessantly trying to suck, and that on this account they refuse the herbage on which they are placed, and take less nourishment than when quietly kept on separate pastures. A few barren ewes are, however, placed with the lambs for the purpose of guiding them, and perhaps teaching them to select

* Lasteyrie on the Merino Sheep, p. 166.

the best and most wholesome food. More lambs are saved than are necessary to keep up the flock, and when they are two years old they are inspected—one-third of the best of them are kept, and the remainder sold. The lambs are never shorn, in order that they may be better able to endure the cold and rain of autumn.

The Prussian sheep-dogs, like almost all on the Continent, are trained to obey the shepherds, and are skilful in guiding the sheep, but they never worry or bite them. There is no natural necessity for it any where; and if flocks are occasionally wild and intractable, bad management and bad treatment have made them so.

### THE SILESIAN SHEEP.

The native sheep were small with long neck and legs, and the head, the belly, and the legs devoid of wool. In the districts of Namslau and Oels was a superior breed, so far as the wool was concerned. They were never folded; they were housed at night, even in summer; the sheep-houses were ill ventilated, and the dung removed from them only twice in the year.

M. Lasteyrie, the chief, or in fact the only authority in these matters, describes the labours of Count von Magnis to improve the Silesian flocks. When he retired to his vast estates at Eckersdorf, on which three thousand sheep were pastured, he found that the gross return from them amounted to only 1200 dollars (225*l.*) He first attempted to improve his smaller sheep by crossing them with the larger breed of Hungary; but not succeeding in this to the extent of his wishes, he had recourse to the Merinos. He spared no expense in order to procure the best rams: he sometimes gave as much as a thousand franks for a single ram. He laboured hard to produce an artificial pasture on a tract of country that would hardly produce any indigenous plants, for on scarcely any part of his estates would the rigour of the climate permit any pasturage during six months of the year. As his power of supporting his sheep increased, he increased their numbers, until his flock became thrice as numerous as at first. In process of time the wool yielded by the greater part of his sheep would bear comparison with that found on the best of Spain, and at length exceeded it in fineness and in value; and in the course of a few years his returns were multiplied more than twenty-fold. For the purpose of the best manufactures the Silesian wool is almost equally valued with the purest and finest Saxony.

### THE HUNGARIAN SHEEP.

The Empress Maria Theresa, witnessing the success with which the Merino sheep were cultivated in Saxony, imported three hundred of them in 1775, and placed them at Mereopail in Hungary. An agricultural school was likewise established by her at the same place; but for a considerable period her laudable exertions were not attended with the desired success. The native sheep, varying in different districts, all of them produced an inferior kind of wool, and had, from time immemorial, been strangely neglected by the farmer. The worst pasture was their lot; they were often half-starved; their winter-houses were unventilated, and the dung removed only twice in the year; and they were consequently subject to numerous and fatal diseases. The milk procured from the animal was the principal, and in some districts might be said to be the only, object of the farmer's attention; and the manufacture of butter and cheese from this produce of the sheep was more valued than the application of the fleece to the manufacture of cloth. It is not therefore to be wondered at that the expectations of the sovereign were disappointed.

The progressive success, however, of the Saxon sheep-husbandry began

at length to make its due impression; and other Merinos were procured from Spain in order to improve the flocks of Hungary. In many cases, and those in late years rapidly increasing, the newly-introduced breed altogether superseded the native one; and if the Hungarian fleece is not, with the exception of a few choice specimens, quite so highly valued as that from Silesia or Saxony, it at least has rivalled and beaten the Spanish Merino in every market in the world. The chief wealth of Hungary is now derived from the cultivation of the sheep. How far the unequal distribution of the land thus employed may be favourable to the happiness of the people is a question which it comes not within the scope of this work to agitate—that it is favourable to the improvement of the sheep there can be no question. A recent statistical account gives to Hungary seven millions of sheep, of which three millions are the exclusive property of Prince Esterhazy.

### HANOVERIAN SHEEP.

Hanover, being so closely connected with the English Government, must not be quite forgotten in the history of the German sheep. There were originally two breeds—one of a larger size, kept on the marshes, the carcase weighing from 80 to 100 lbs., and the fleece averaging from 5 to 6 lbs., but the flesh not good, and the wool coarse; and a smaller breed, resembling the old Rhenish and Saxon, with shorter wool, yet coarse of its kind, and of little value. Both kinds were badly managed. The farmer used to keep as many only as would supply his family with wool and milk. Almost every cottager had two or three. They were chained in pairs, and picked up their living on the dykes and other unenclosed spots. They were kept chiefly for their milk, all the Hanoverian cheese being made of ewes' milk alone. They were wretchedly poor, and when shorn looked little better than skeletons *.

Mr. Hodskin says that the smaller sheep have now been crossed with the Merinos, and yield fleeces as fine as any of the Merinos, weighing on the ewe from 2 to 2½ lbs., and on the ram from 4 to 4½ lbs., and that these sheep are now cultivated for the wool principally or almost exclusively; and he adds that the peace and communication with England had nearly doubled its price †.

The superiority of the German wool over that yielded by the Spanish Merinos is now fully established. Mr. Jowitt, in his evidence before the House of Lords, says, "I began with the Spanish wool; I then changed to the German, on account of its superior quality—in the manufacturer's phrase—proving better, and making a softer cloth. I was also able to spin it to a greater length—the very qualities in which the English wool is deficient." The Spanish wool is, nevertheless, often finer than the German; at the same price it generally is finer, but it has not the numerous curves and serrations. The trade in German wool is of recent date: it has sprung up since the year 1800. The manufacturers were at first prejudiced against it. They said that it was dirty, and that there was great loss of weight. The German wool is now, however, sent over in a better state; and its softness and spinning qualities are placed beyond dispute.

Mr. W. Ireland gives, in his evidence on the same occasion, a curious

* Farmer's Magazine, May, 1820.

† "The Hanoverian shepherds are generally dressed almost entirely in white linen. They wear large hats cocked up behind, and ornamented with a large steel buckle, and the men look very respectable and clean. They are paid in proportion to the success of the flock, and have an interest in watching over its improvement. They receive a ninth of the profits; but they also contribute on extraordinary occasions, such as buying oil-cake for winter food, when necessary. They also contribute one-ninth to the expenses of new stock. The head shepherd has two-ninths of the profits."—Hodskin's Travels in Germany, 1826.

account of the wool-stapling business in Germany. He says that the farms are generally small, and the wool collected by the Jews, who go about with a cart and pair of horses to the different houses. It is a large farm that has ten bags of wool. These are taken to the large merchants, by whom the fleeces are carefully examined, and those that are nearly of one quality are thrown together. The fleeces being thus arranged, the wools are sorted, and shipped by these merchants down to Hamburgh, and there consigned for England. The Jews frequently convey it to Hamburgh themselves, and most of the leading houses have their agents there. It is a fair open market, like those of Breslaw and Leipsic. He adds, "There is a great deal of expense and attention bestowed on the sheep: they are housed and nursed as carefully as the race-horse is in a sporting stable."

In every part of Germany and Austria, there are not only an increasing number of sheep bred purely or nearly from the Merinos, but there are many more that have a little of the Spanish blood in them. About the year 1819 the inferior wool from these sheep began to be imported, and was tried by the manufacturers. It was found to make a good second cloth, as good as used to be made by the South Down wool, and with less trouble, and consequently it began to be extensively used, not merely because at first it could be procured at a less price than the South Down wool, but it continued to be preferred when it cost two and three pence per pound more than the British wool. It made a softer cloth, and with less expense and trouble and loss in the manufacture. The importation of wool of this kind having once begun, an inferior and a still inferior description has followed, and which has often been perfectly unsaleable. This subject will be resumed hereafter.

### THE FLEMISH AND DUTCH SHEEP.

It has already been stated (p. 121) that in the early part of the seventeenth century, the large Guinea sheep was introduced into the islands near the Texel and into Groningen, and called the *mouton Flandrin*, or Texel sheep. They there found a pasture suited to the improvement of their naturally long and gaunt form; they were crossed with some of the large native breeds; the English long-woolled sheep, and particularly the Romney, contributed more to their amelioration, and they are now a singular, but in many respects a valuable breed. They have somewhat decreased in size: they are seldom more than two feet six inches in height; they are polled, with long pendent ears; the leg is rather inclined to be long; the tail is short and large, and covered with wool; the fleece averages from ten to twelve inches in length, but it is far from being fine, and is devoted to the preparation of coarser goods.

In Friesland is a similar breed of sheep, but with more of British blood. It is of a larger size, measuring sometimes two feet nine inches in height, without horns, having pendent ears, a head so long as almost to approach to deformity, and the tail long and small, and generally devoid of wool. The wool is long, finer, and with more numerous curves, and can be appropriated to more valuable purposes. They have considerable resemblance to the British or rather the Irish long-woolled breed; but they have never quite cast off their original lean appearance and disinclination to fatten. They are more prolific than any English breed; their milk is valuable, and is used by the Dutch and Flemings in the manufacture of a considerable quantity of cheese of good quality*.

* An anonymous French work, but published by royal authority in 1763, and entitled "Instructions for breeding and perfecting the best kind of Sheep in Flanders," describes four kinds of Flemish sheep: the first he calls *frises*—the wool curled, frizzled at its ex-

The Merino sheep gradually found their way into Belgium and Holland. The precise date of their arrival is not recorded; but there was so essential a difference in the character and habits of the Flemish and Spanish sheep, and in the climate and soil and productions of the two countries, that, as might be readily expected, the experiment altogether failed.

In 1789, according to M. Lasteyrie, Mr. Twent, not discouraged by the failure of others, imported a small flock of Merinos. The sheep soon recovered the fatigue of their voyage, became reconciled to their new food and climate, and not only began to display their superiority to any of the native breeds, but continued to retain all their own peculiar excellence. In these countries, however, as in too many others, the value of the Spanish sheep was not duly appreciated by the agriculturist; and they never to any great extent established themselves in Belgium or Holland, either as a distinct breed, or as a source whence the native breed might derive much improvement.

### THE MERINO SHEEP IN BRITAIN.

England was late in attempting to naturalize the Spanish sheep, or to improve her own breed by an intermixture with them. There was some excuse for this, for she already possessed a clothing wool equal or superior to that of any other sheep except those of Spain; and her maritime habits and the extent of her commerce gave her easy access to the finer wools, far less necessary to the manufacturer at that period than fashion has now made them: at the same time her native combing wool was perfectly unrivalled. A few Merino sheep, however, were introduced here and there, but they had much prejudice to contend with, and their value was not duly appreciated.

The monarch who, at the close of the eighteenth century, swayed the sceptre of Great Britain, was an ardent agriculturist, and he determined to give this celebrated breed of sheep a fair trial on his own farms. In the year 1787 measures were taken for the collection and importation of a little flock of Merinos. They were collected in Estremadura, on the borders of Portugal—a few from one flock, and a few from another. It

tremities. It answers to the second species mentioned in the text. He says that "it unites in itself the perfections belonging to every other breed without their defects: its walk is firm; its deportment noble; its form well proportioned in all its parts, announcing a good constitution and a healthy temperament, and exempt from the maladies so common to other breeds. The length of its wool is in proportion to its height, and it does not disfigure the animal as in the English sheep, whose fleece is a burdensome weight, especially at the return of spring (*de la belle saison*). The Flemish sheep carries nothing about him that in the least detracts from his beauty. His wool is white and without spot—it is of a dazzling whiteness; he is contented everywhere—everywhere he becomes a citizen of the place he inhabits (*il devient citoyen du lieu qu'il habite*)." It is a good kind of sheep enough, but it owes much of its value to English blood; and, after all, the Belgians and the Dutch are compelled to import annually three millions and a half of pounds of British wool, in order to make that of this unrivalled sheep available for the manufacture of the finest stuffs. The average price of this kind of sheep in store condition was about eighteen livres at that time, and thirty livres when fat, and the carcase weighed from 90 to 130lbs.

The second kind of Flemish sheep (that described first in the text) was called *grainés*, grained or granulated. The yolk was abundant, but lay on the fleece in a singular manner; the fibres appeared like a succession of grains attached to one another. A few of these sheep are occasionally seen at the present day. The staple was about nine inches long, and not so fine as that of the *frises*.

A third, or *middle* wool, did not exceed four or five inches in length. It was almost as fine as that from the *grainé*, but inferior to that from the *frise*.

The fourth was a decided long-woolled breed, that which has already been described (p. 158) as the sheep of Picardy and Normandy.

The fifth was the wool *rasis*, so called from its shortness and hardness, not being more than three inches in length, found in small quantity, and little valued.

was a kind of smuggling transaction; and as they could not be shipped from any Spanish port without a license from the King of Spain, they were driven through Portugal and embarked at Lisbon, landed at Portsmouth, and thence conducted to the king's farm at Kew. They did not please the royal adventurer. Hastily selected, or obtained as they could be from various proprietors and various districts, there was no uniformity about them; they could not be said fairly to exhibit the true character of their breed, nor was it safe to make any experiment with them.

It was then determined to make direct application to the Spanish monarch for permission to select some sheep from one of the best flocks. This was liberally and promptly granted; and a little flock was draughted of the Negrette breed, the most valuable of the migratory flocks, and the exportation of which was expressly prohibited by law. They arrived in England in 1791, and were immediately transferred to Kew: the sheep previously imported were destroyed, or otherwise disposed of, and the experiment of the naturalization of the Merinos, and the crossing of them with the British sheep, may be then said to have commenced.

The management of these newly-imported flocks does not seem at first to have been very skilfully conducted. They were placed on a moist, and, perhaps, too luxuriant soil; and they became affected with the foot-rot; and in some situations, and to a fearful extent, their numbers were thinned by the liver-rot. This was, by those who were prejudiced against them, said to be the fault of the sheep; but a little change in the pasture showed that it was altogether attributable to the carelessness of the shepherd. The first winter had scarcely passed, ere they were acknowledged by impartial observers to be perfectly naturalized. They were as free from disease as the best of the British flocks.

Their wool was unaffected by the change of climate. The product of the second and third shearings was compared with the best samples of the imported Spanish wool, and it yielded not to them in fineness or felting quality. Many a year afterwards the experiment was repeated, and with the same success.

Several of the British ewes were crossed with the Merino ram, and the following were some of the early results: Mr. Bartley experimented on the Wiltshires, and after a few crossings the ewes became hornless; they had acquired the almost perfect shape of the Merino; the wool increased from 3½ to nearly 6 lbs. per fleece, and it was little inferior to that from the pure Spanish sheep*.

Mr. Tollet crossed the Ryelands with the newly-imported sheep, and he selected those of the native breed which carried the best clothing wool; and he found that the fleece which used to weigh little more than 2 lbs. increased to 3 lbs., and its average value rose from 2*s.* to 3*s.* per lb. Dr. Parry also crossed the Ryelands with the Merinos. After the fourth cross the wool was as fine and valuable as that of pure Merinos†.

* Agricultural Mag., May, 1803.

† The following account of this best breed of Anglo-Merino sheep may not be unacceptable to the reader: "They are a beeed of considerable bone, length, and breadth of carcase, but wanting in that rounding of form which seems to constitute the beauty of our best or most improved native breeds. They are docile to a remarkable degree, leading about very handily. Their bodies, bellies, and legs, down to the hoofs, are covered with a thick elastic fur, which certainly must be a greater protection against either wet or cold than the open fleeces of most of our native sheep. The best of the wethers weigh on the average about 8½ stones, or 17lbs. per quarter; and the mutton always bore a preference in the market."—Agricultural Mag., Aug. 1806.

As a trial of the manufacturing worth of the wool of this sheep, a certain quantity of Dr. Parry's wool, from Ryeland ewes, and crossed by the King's and Lord Somerville's rams to the fourth generation, was selected, and an equal quantity taken from a pile of

Mr. Coke experimented on both the Ryelands and the South Downs, and he affirmed at one of the Holkham meetings, that "the cross of the Merino and the South Down was much better than that of the Merino and the Ryeland*."

Mr. Hose, of Melton Mowbray, put a certain number of Leicester ewes to a ram of the same breed, and an equal number to a Merino ram. The result was, that the Leicester fleece weighed 7lbs., and that from the cross with the Merino 8lbs.; and that the former brought in the market 1*s.* per lb., and the latter, 1*s.* 6*d.*, being a gain of 5*s.* on the fleece. The carcase of the former, however, weighed 27 lbs. per quarter, the latter only 25 lbs., being a loss of 8lbs. of mutton.

The Merinos found some early and zealous advocates, and among them Sir Joseph Banks, and Lord Somerville (who, at his own expense, imported a considerable flock of them); and Dr. Parry stood foremost in publicly recommending an almost universal trial of them, either pure, or mixed with the native breeds. One writer (Mr. Bartley) thus enumerates their supposed excellencies: "They produce wool in a much greater quantity than any species of British sheep from equal quantities of pasture, and equal feed. Far from the slightest appearance of deterioration, they manifest indubitable evidence of general progressive improvement, especially in the quality and value of the fleece. They possess an aptitude to fatten at an early period, and the quality of the mutton is excellent. They resist the effect of cold, inclement weather, to a degree, equal at least to the hardiest of our native breeds, being defended by a closer, heavier, and more impervious covering. They produce short wool, in no way inferior to that imported from Spain; and a single cross will considerably increase the weight of the fleece in our long-woolled sheep, still retaining the suitable staple as combing wool †."

On the other hand, they had much prejudice to encounter, arising from their gaunt and unthrifty form—their actual deficiency of carcase—the inapplicability of their wool to the manufactures then most in request—and the natural prejudice of the inhabitants of a wool-growing country against any rival of the sheep which they and their forefathers had, from time immemorial, successfully cultivated. Their warmest advocate, Sir Joseph Banks, thus describes the difficulty which attended the establishment of the royal flock: "It was impossible to find a purchaser willing to give even a moderate price for the sheep or their wool. The shape of the sheep did not please the graziers; and the wool-staplers were utterly unable to judge of the merit of the wool, it being an article so many times finer and of more value than anything of the kind that had ever before passed through their hands ‡."

It was thirteen years after the arrival of the Negrette flock, ere they had been able to establish themselves in the good opinion of a sufficient number of agriculturists to render it prudent to expose them to sale by public

prime Leonesa Spanish wool; both of them were dyed and delivered to the manufacturer. According to the account of the foreman of the manufactory, "Dr. Parry's wool and cloth, *in every state*, worked more kindly than the other." When finished, his cloth was the finest, and that from the Spanish wool the stoutest. The cloths were numbered, and submitted to the inspection of several manufacturers and drapers, who unanimously decided in favour of the number which the Anglo-Merino bore; and the opinion of the Committee, as extracted from the Bath Society's Papers, was, that Dr. Parry "had by his zeal, diligence, and perseverance and activity, accomplished the grand object of producing in the British climate, and from British soil, wool equal to that usually imported from Spain; and that, by so doing, he had merited the warmest thanks of the country in general, and that Society in particular."—Bath Papers, vol. ii. p. 160.

* Agricultural Mag., July, 1810. † Ibid., Nov., 1804.

‡ Communications to the Board of Agriculture, vol. vi. Part 2.

auction. In 1804 the first sale took place. It was attended by the friends of the Merinos, and by others who, led thither by curiosity, were induced to become purchasers. One of the rams sold for 42 guineas, and two of the ewes for 11 guineas each. The average price of the rams was 19*l.* 14*s.*, and that of the ewes, 8*l.* 15*s.* 6*d.* each*.

At the second sale, in August, 1805, seventeen rams and twenty-one ewes were sold for 1148*l.* 14*s.*, being at the average of rather more than 30*l.* each †.

In 1808, the highest price given for a ram was 74*l.* 17*s.* The average price of rams was 33*l.* 10*s.*, and that of ewes, 23*l.* 12*s.* 6*d.*

The Merinos might now be considered, as, to a certain degree, established in public favour. They, with common management, still retained their fleece as heavy and as fine as when first imported; and, whatever breed they crossed, the uniform result was improvement, both in the weight and fineness of the wool, with some, but not proportionate, loss of carcase. They were more and more eagerly sought after, and experimented with; and in the sale of 1810, thirty-three rams sold for 1920*l.* 9*s.*, being on an average more than 58*l.* each. One full-mouthed Negrette ram was sold to Colonel Searle for 173 guineas; one for 134 guineas to Sir Home Popham; one for 116 guineas to Mr. Gale; one for 105 guineas to Mr. Sumner; and one for 101 guineas to Mr. Wools. Of the ewes, a full-mouthed Negrette was sold to the last-mentioned gentleman for 70 guineas, and two Paular ones for 61 guineas each, and a third for 65 guineas. One Paular was disposed of to Mr. Down for 92 guineas, and another to Mr. Willis for 60 guineas: 70 of them were sold in the whole, and they fetched, on an average, 37*l.* 10*s.* per head ‡.

The first advocates of the Spanish breed of sheep saw all their predictions fully realized; and the number of sheep-masters was rapidly diminishing who had prejudice, or prudence, or foresight sufficient to resist the influence of the widely-spreading Merino-mania.

A Merino Society was instituted in the following year. It started with a phalanx of members, which, from their number, station, and influence, apparently secured its perpetuity. Sir Joseph Banks was the President. Fifty-four vice-presidents were appointed, and local committees were established in every county of England, Scotland, Wales, and Ireland. Premiums of 20 guineas were offered for the best pure Merino ram not more than twenty-eight months old, and 10 guineas for the second best; 20 guineas for the best ram not more than sixteen months old, and 10 guineas for the second; 10 guineas for the three best pure Merino ewes; 10 guineas for the best pen (consisting of five) of pure Merino wethers; 10 guineas each for the best pen of the first, second, third, and fourth cross of the Merinos with British sheep; and 10 guineas for the best fleece.

No more striking instance can be produced of the fallacy of human expectation and judgment, than the establishment of this Society. From this very period is to be dated the rapid decay of the Merinos in public estimation. They are a most valuable breed of sheep; they yield a wool, which in fineness and manufacturing quality was then unrivalled; they have materially improved the fleece of every short-woolled sheep which they have crossed, and have increased the length and weight of the staple, and adapted it for finer worsted stuffs; and it is not improbable, although the experiment has never been fairly tried, that, with careful management, the crosses being few and far between—they would give a finer and more

* Communications to the Board of Agriculture, vol. vi. Part 2.
† Agricultural Mag., Sept., 1805. ‡ Ibid., Sept., 1810.

valuable fleece to the long-woolled breeds; not injuring it for the purposes to which it is already applied, and rendering it useful for many other fabrics. It follows from this, that in every country where the farmer looks to the fleece, if not for his sole, yet his principal, remuneration, the Merino will be duly valued, and will gradually supersede every other breed. In Great Britain, nevertheless, where the system of artificial feeding is carried to so great a degree of perfection—where the sheep is so early and so profitably brought to the market—that breed, however it may ultimately increase the value of the wool, can never be adopted, which is deficient, as the Merinos undeniably are, in the principle of early maturity, and general propensity to fatten.

Another circumstance, and one of still greater consequence is, that the establishment of the Spanish sheep in other countries, and the additional quantity of their wool that is grown, have produced a revolution in the cloth manufacture. Those fabrics with which our ancestors were content are no longer articles of extensive commerce: they are no longer worn; and the wools of which they were composed are devoted to other purposes, and those so numerous and important, that there is, in fact, a greater demand for British short wool now, than there was previous to the introduction of the Merino sheep—a greater demand than the growers of short wool are able to supply. The short wool being now lengthened in the staple so much so as to have acquired a new name, and having also increased in quantity and weight on the sheep, and the carcase having likewise increased in weight, and the finer foreign wool being now to be purchased at a cheaper rate than it could be grown, it would be bad policy in the farmer to alter materially the character of the wool; for its greater quantity, added to the heavier carcase, will produce a more certain, and on the whole, a better remuneration than a finer, but lighter fleece, accompanied by a lighter carcase, could possibly give him *.

Mr. Coke, who had expressed the high opinion which has been quoted, (see page 179,) of the good result of crossing the South Down with the Merinos, was one of the first honourably and fully to retract that judgment which he had somewhat too hastily given. In the autumn of the very year in which the Merino Society was instituted, he thus addressed the meeting at Holkham:—"I feel it my duty to state my latest opinion of the

* Mr. Ellman, in his examination before the House of Lords, says, that "he abandoned the Merinos from the difficulty he had in selling them in a lean state. The graziers did not then like to have them. He then tried to feed them himself, but he found that he could fatten three South Downs where he could one Merino. He treated them as he should other sheep, but he never could fatten one of them well."

On the other hand, Mr. Trimmer, who had a considerable flock of them, says, "That in disposition to fatten they equal the South Downs, and the mutton is of the first quality."

Mr. Webb Hall, a warm advocate of the Merinos, says, that "They are the finest mutton in the world when made fat, but at present they are an unimproved-bodied sheep, capable, he thinks, of being still made the most valuable animal in this country."—Evidence before the House of Lords, in 1828.

The public has decided between these gentlemen. The Merinos did not afford a remunerating price in the carcase, and they were abandoned. As to the barrenness and bad nursing of the Anglo-Merinos, the prejudice existing against the Merinos may not be well founded to its full extent. That is strong testimony which Lord Somerville gives on this point. "On their first importation, there was a great deficiency of milk in the ewes, as well as a tendency to barrenness, which is now ascertained to have arisen from the severe journeys to which this race of sheep is twice in the year subjected when in Spain. They are now regular in their time of lambing; their udders are as full, and they are as good nurses, as any sheep I have ever seen. It was not till some years after their arrival in this country, when they had become inured to the climate, that any instance of double lambs occurred; now it is not an unfrequent occurrence."—Lord Somerville's Facts and Observations, p. 14.

effects of the cross of a part of my South Down flocks with Merino tups, and I wish it could be more favourable. From the further trial which I have made, (this, the fourth year,) I must candidly confess that I have reason to believe that, however one cross may answer, a farther progress will not prove advantageous to the breeder *." The real state of the fact, however, is, that from the year of the establishment of the Merino Society, and the opportunity which agriculturists had of putting to the test, on a larger scale, the value of the Merino sheep, they have sunk in the estimation of the sheep-master. There are few flocks of the pure Merinos now existing, and those few are rapidly declining—*the produce not being beneficial to the grower.*

It is folly now to say, as was long and even lately affirmed by the zealous advocates of the Merinos, that "the leading breeders of sheep had a great stake in the flocks which they already possessed, and the practical breeders of eminence, who made trial of them, were warped by prejudice and interest;" that dishonourable measures were resorted to in order to blast their fame; that "wool from inferior and mixed flocks of all kinds was attempted to be passed as the best and most pure, and that rams from inferior flocks were passed as those of the first blood †." After the establishment of the annual sales and the Merino Society, the case was brought fairly before the proper tribunal; or rather, the claims of the Merinos were backed with a zeal and influence seemingly irresistible; yet the British sheep-breeders, and the British public, decided, that no great and permanent change could be effected in the British sheep by means of the Merinos, without a more than proportionate loss.‡

The public are always too prone to run into extremes, and the Merinos are now as much unjustly depreciated as they were somewhat too hastily overvalued. Occasion will be found, in an after part of this work, to show how much good could be done, by one, or by an occasional cross of the Merino, on some breeds, and in certain localities.

The Saxon Merinos yield, as has been already seen, a finer and more valuable wool than any which is imported from Spain. At page 171 is the portrait of a Saxon Merino belonging to that experienced and scientific agriculturist, Lord Western, and with which he is improving his former Spanish breed, and crossing some of the native sheep. Sir H. Vavasour, of Melbourne Hall, near York, has likewise imported some Merino shearling ewes, and a ram from Saxony. The Saxony sheep are decidedly superior to those brought immediately from Spain, not only in their wool, but their general form and propensity to fatten. If the British sheep is ever destined to yield a finer wool, sacrificing little or nothing in point of carcase, it must be by means of the Saxon, and not the direct Spanish Merino. These were selected from a distinguished flock in the neighbourhood of Dresden; they were brought by land to Hamburgh, a distance of between five and six hundred miles, and thence shipped for Hull. Neither their

*Agricultural Mag., Aug., 1811. †Trimmer's Practical Observations.

‡ The reasoning of Mr. Plint on this point, in a letter with which he favoured the author, is decisive:—"I always thought the speculation of cultivating and shearing the Merinos a decidedly foolish and unprofitable one. We can consume all the coarse wool we grow, and more if we could get it; and, taking carcase and weight of wool together, the long-woolled sheep is more profitable by far than the Anglo-Merino. Besides, if the English breeds were to any considerable extent superseded by the Merinos, the price of that wool would fall, and long wools would rise; and the advantage of growing fine wool, on account of its high price, would slip through the fingers of the agriculturist. If we could grow more of both kinds, well and good; but in present circumstances, a profit by foreign wool is as good as a profit by fine wool, and we can only have one; and it is the part of wisdom to take that which is easiest got."

long journey, nor their sea voyage, in the slightest degree impaired their condition,—a proof of soundness of constitution which promises something as to their future usefulness.

Few of the Anglo-Merinos remain either in Scotland or Wales. Their reputation began to diminish, before it was deemed prudent to expose them to the open country and inclement seasons of the one, or that it would be possible for them to obtain a livelihood on the mountains of the other.

Ireland, however, has had some opportunities of testing the value of the Merino sheep. Reference has already been made to the numerous Merino flocks of Messrs. Nowlan, of Kilkenny. It originally sprung from seven ewes and one ram of the Paular and Negrette blood, which had been presented to those gentlemen in 1810, and a few that were added to them in the following year. In 1820 they had increased to 600. The quality of the wool had improved rather than deteriorated. The average weight of the clip in 1819 was 6½ lbs., the price of the wool was 3*s.*, amounting to 19*s.* 6*d.* The average number of sheep supported by one acre is calculated at eight, including the land that produced the hay and turnips for winter food, making the gross value of the wool per acre to be 7*l.* 16*s.* In scouring from the grease, this wool lost 11 lbs. in 20; and after being washed on the sheep's back, at least 7½ lbs. in 20 *.

There is an account, in the Agricultural Magazine for 1810, of "ten thousand Merino sheep being purchased by Sir James Stuart, and sent over to Ireland. They arrived in a very sickly state, and many hundreds of them perished; but enough were preserved for the most extensive breeding purposes." Little trace of the improvement effected by the Merino sheep is now to be discovered; but much more of the progressive value of the Irish flocks is to be attributed to the South Downs, and yet more to the Leicesters.

### THE NEW SOUTH WALES SHEEP.

The British settlements in New South Wales (part of the eastern coast of New Holland) were originally intended for the reception of convicts, whose labour for a certain number of years, as a punishment for their crimes, might be rendered useful either to the free colonists or the mother country. The first party of them arrived at Botany Bay in January, 1788, whence they were soon removed to a more convenient situation at a little distance—Port Jackson. The climate, although its temperature in summer was considerably higher than that of England, appeared to be healthy. It had only one serious inconvenience,—that it was subject to periodical droughts, fortunately of unfrequent occurrence, but severe and lasting when they came. "The great drought which commenced in 1826, did not terminate until 1829. Very little rain fell during the whole of this period, and for more than six months there was not a single shower †."

The soil was exceedingly variable in different places. A considerable portion of it was very productive, but at least an equal part was comparatively barren. On the whole, it evidently promised well as a pastoral country. It had no sheep of its own, but a sufficient number were procured from Bengal to provide the colonists with mutton and wool, and to establish a permanent flock. They could be speedily obtained from that country, but they did not promise well. They had large heads, Roman noses and slouch ears; they were extremely narrow in the chest; they had plain and narrow shoulders; very high curved backs, a coarse, hairy fleece, and tremendously long legs ‡. This was an accumulation of bad

* Farmer's Mag., Aug., 1820. † M'Culloch's Dictionary, art. Sydney.
‡ Widowson's Present State of Van Diemen's Land, p. 142.

qualities. Yet such were the primitive New Holland sheep, more, according to Mr. Atkinson, resembling goats than sheep *, and from such animals emanated all the improved flocks now in the colony. The climate worked wonders upon them. New South Wales seemed to be an exception to the fundamental principle of the paramount influence of blood, and the more subsidiary one of soil and climate. In the first two or three years these sheep were, in a manner, changed; the hair was comparatively gone, and a fleece of wool, although of no great fineness, succeeded.

Shortly afterwards there were considerable importations of South Down and Leicester sheep, and the change was undeniably more important. Both the fleece and the carcase were doubled in value; but there was a limit beyond which they would not have much advanced. The colonists bred principally for the carcase. They did so more decidedly after the arrival of the South Downs and Leicesters than before, because the sheep rapidly assumed the roundness and compactness of form which is essential to early maturity.

The progress of the colony was nevertheless comparatively slow. In the year 1800, twelve years after the arrival of the first ship, there were but 6124 sheep in the whole settlement.

At this period, the Merinos were established in several parts of Europe, and had begun to gain footing in England. The colonists had long observed the influence of climate, or soil or management, on the primitive sheep of New South Wales. The hair had been changed for wool, and that wool had been yearly improving. The crosses with the South Down and the Leicester produced a fleece equal in fineness and value to that of the pure sheep of these breeds in the mother country. The colonists of Australia were therefore anxious to try how they should succeed with the Merinos. A few were imported from England, and the experiment was satisfactory beyond their expectation. The third or fourth cross with the then prevalent sheep of the colony produced an animal with a fleece equal to that of the pure Merino in Europe; and the wool of the pure breed seemed to improve as rapidly as that of the native breed had done. The colony now began rapidly to flourish. The number of voluntary settlers increased. The number of sheep, in the next three years, had risen to 10,157 †; in 1813 they had increased to 65,121; in 1817 they were 170,420; and in 1828 they amounted to 536,391 ‡.

Captain M'Arthur, a zealous agriculturist, laid the foundation for still greater improvement. He reasoned, that if the fleece of the common Merino sheep became finer and softer on the soil, and under the climate of New South Wales, it was not improbable that even the Saxony wool might somewhat increase in value, and he imported some sheep direct from Germany. It would not perhaps be truly said, that the quality of the Saxony fleece was improved by the change of climate—perhaps it was somewhat deteriorated—but it soon became sufficiently evident that its properties were superior to any that the colony had hitherto possessed. They who were best capable of judging, and who could have no temptation to deceive—the wool-staplers and the manufacturers, shall here speak for themselves. Mr. H. Hughes, a Blackwell Hall factor,—"The qualities of the wool were originally very bad. Latterly they have been of varied qualities, but they all possess an extraordinary softness which the manufacturers here so much admire, and they are sought for more than any other description of wools. I should conceive that that country is adequate to the growth of as much wool of a fine description

* Atkinson's Agriculture of New South Wales.
† Collins's New South Wales, p. 549.
‡ Wentworth's New South Wales, p. 136.

as will ever be wanted by the manufacturers of England. This wool would also mix beautifully with our own wools, which other foreign wools do not always, on account of the harshness of the fibre *." In a second examination he says:—" There is no other wool which spins so well as the Australian, from its length of staple and peculiar softness. The finer description of stuff, which is now so much manufactured, is made of this wool. Whether from the climate or the herbage, or both, the wool has improved in softness and in staple too; and I have no doubt that we shall shortly derive the whole of our supplies of foreign wool from that part of the globe †." This is high praise, and the fulfilment of Mr. Hughes's prediction would be a consummation devoutly to be wished.

Mr. Donaldson, a wool-merchant, says,—" The Australian wools have much improved. They are decidedly preferable to the apparently slender description of German wools. From their superior softness of texture, they are better adapted than the other description of wools to mix with the harder staple of the English wools. They have comparatively very peculiar qualities. They have a softness and silkiness about them which, when worked into cloth, shows itself more distinctly than in the raw material of the same description ‡." Mr. Ebsworth says, that " the wool of Mr. M'Arthur has made some of the finest cloth that has ever been seen in this country §." One bag of Mr. M'Arthur's wool, weighing one hundred weight, and properly sorted, sold at the unprecedented price of 10*s.* per pound. It will, however, probably, appear by-and-bye, that the actual value of these wools has been somewhat exaggerated, and that although the exportation of them has rapidly increased, there are circumstances about these colonies and the woollen manufactures generally, which will ere long assign to them a limit which they cannot pass.

The principal complaint against the Australian wool used to be the dirty state in which it was sent to the market. This is now in a great measure remedied. One objection to New South Wales is the want of water; but where that is at hand, even greater care than in England is taken to cleanse the wool from all impurity. On two or three mornings previous to the shearing, the sheep are compelled to swim through some clear stream. They are likewise driven again and again through the river on the morning of the washing day itself, and made to stand dripping in the pen until they are wanted. In Captain M'Arthur's establishment, each sheep is dipped in a cauldron of warm water, previous to being washed, by which the grease and dirt are more effectually softened and separated from the fleece.

A place is selected in the river, where there is a sandy bottom, and a sufficient depth of water for the sheep to swim. The lower washer first gives the sheep a good rubbing, and passes him to the man above him; and after, that no impurity may be left, the animal is forced to swim a little way up the stream.

On the sheep the wool is shorn at one year's growth, and on the lamb at six months, which causes the Australian lamb's wool to bear so low a price, its staple being very short ‖.

The average weight of a fleece of superior quality is from 3 to 3½ lbs.; but fleeces of 5 lbs. are not uncommon; and some inferior, yet not bad fleeces, have weighed 7 lbs ¶.

Dr. Lang, however, states the average to be from 2 to 2½lbs. per sheep**.

* Evidence before the House of Lords. † Ditto. ‡ Ditto. § Ditto.
‖ Cunningham's Two Years in South Wales, vol. i. p. 253.
¶ Breton's Excursions in New South Wales.
** Lang's Historical and Statistical Account of New South Wales, vol. i. p. 351.

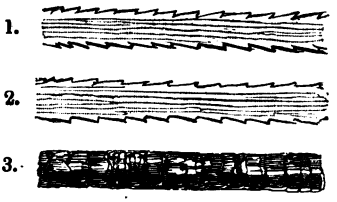
The increased exportation of wool is a satisfactory proof of the growing estimation in which it is held.

In 1810 it was only 167 lbs.; in 1820 it had increased to 99,415 lbs.; in 1821 it was 175,433 lbs.; in 1822, 138,498 lbs.; in 1823, 477,261 lbs.; in 1824, 382,907 lbs.; in 1825, 323,925 lbs.; in 1826, 806,302 lbs.; in 1827, 320,683 lbs.; in 1828, 967,814 lbs.; in 1829, 913,322 lbs.; in 1830, 973,336 lbs.; in 1831, 1,134,134 lbs.; in 1832, the quantity of New South Wales and Van Dieman's Land wool amounted to 2,377,057 lbs.; and, in 1833, to 3,516,869 lbs*.

The increase, in one year, of 1,139,812 lbs. shows the prosperity of the colonies, and the improvement of the wool; but when during the same year the increase of the importation of wool from Germany was 5,537,881 lbs., it must be confessed that it gives little prospect of the speedy arrival of the time when the Australian colonies will supply the mother country with the full quantity of fine wool that she requires. The market price in March, 1834, was 5*s.* 5*d.* per lb. for the best Saxon wool, and 4*s.* 6*d.* for the best Australian: while this proves that the wool of New South Wales has become more valuable than that of the Spanish Merino, which reached only 4*s.*, it does not promise that complete victory which, according to Messrs. Hughes and Donaldson, was to be gained over every competitor. Indeed, such a victory as this is not to be expected. Sheep cannot be kept in right condition, nor the quality of the fleece preserved from deterioration, without a great deal more care than is bestowed upon them, or can be bestowed, in these colonies. The very paucity of the inhabitants will put a limit to the growth of wool very far short of a full supply. In addition to this, it may be asked, if this supply could be obtained, and the immense importation from Germany continued as much at our command as it is at present, what price would fine wool fetch, or how could it pay the Australian grower? The present result, however, is highly pleasing, and there can be no doubt that Australia will, ere long, become one of the most valuable of the British foreign possessions: but it requires, and it deserves, far more assistance and encouragement than it has hitherto received from the mother country.

The microscope very satisfactorily illustrates the character and actual value of these wools.

A fibre of fair, but not very superior, Australian wool, was subjected to its power.




1. *Transparent.* 2. *Combed.* 3. *Opaque.*

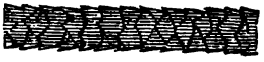
It proved (see 1.) to be (when viewed as a transparent object) $\frac{1}{750}$th of an inch in diameter, and the number of serrations were 1920 in the space of an inch. It was therefore coarser than the Saxony wool, which was only $\frac{1}{840}$th part of an inch, and it was of precisely the same diameter as the picklock Merino. It was decidedly inferior to both in the number of serrations—the Saxony presenting 2720, and the picklock Merino 2560: but the edges were definite, although not projecting much, and some of

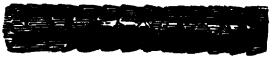
* M'Culloch's Dict., art. *Wool*; and Widowson's Van Diemen's Land, p. 50.

them were very sharp, and even hooked, accounting for its felting property. When viewed as an opaque object (3.), the cups were placed at regular distances, with evident development of the Vandyke structure, but the Vandykes small, and far from being thickly set; thus, probably, being more pliable, and accounting for the peculiar softness described by Messrs. Hughes and Donaldson. The combed wool (2.) was then examined: its edges were tolerably preserved, and even some of the sharp barbs, thus corresponding with its acknowledged properties as a combing wool.

Through the kindness of Mr. Symonds, the author had the opportunity of examining another specimen of New South Wales wool, which was selling in the British market (in September, 1835) at 2*s.* 6*d.* per lb. When viewed as a transparent object (1.), it also was the 750th part of an inch in diameter, and the serrations were 2080 in the space of an inch. As an opaque object (2.), the structure of the cups was well developed. It consisted of a few broad leaves, diverging from each other towards the apex, and affording each other little support at the base. It was easy to imagine that a cup or joint like this would be flexible to a very considerable extent.

*New South Wales Wool.*

1. 

2. 

1. *Transparent.* 1. *Opaque.*

*M'Arthur's Wool.*

1.

2.

1. *Transparent.* 2. *Opaque.*

To the same gentleman we are indebted for a sample of M'Arthur's Australian wool. The cuts of this and the preceding wool are placed together on account of the singular difference in the structure of the serrations or cups, and beautifully corresponding with the manufacturing properties of each.

The serrations (1.) were 2400 in the space of an inch—they were very sharp, and in appearance almost barbed. The fibre was $\frac{1}{750}$th of an inch in diameter. When viewed as an opaque object (2.), the leaves of the cup were unusually long and finely pointed, giving the idea, not only of a good felting wool, but of a flexible one. The leaves of the cup or joint would readily entangle with each other, on account of their sharpness and their length—and being so narrow as they are, and even towards the base, they would readily bend.

But these are not the wools that Mr. Hughes' account of them would lead one to expect: there is, even in the two inferior samples, sufficient to account for their peculiar softness. There is in the construction of the cup a singular difference, evidently marking the different origin of the sheep from which the samples were taken; and there is also—(is Mr. Hughes right in his assertion, that 'the climate, or the herbage, or both, have been exerting their influence'?)—a marked difference, not only in the length but in the structure of the Saxon wool, as obtained direct from

Germany and imported from Australia. The fibre of the Australian is considerably longer, but it is not so fine—the serrations are not so numerous—they are of a different character, seemingly giving pliability and softness to the one, and feltiness to the other. (see pp. 89 and 90.)

In truth, the manufacturer has properly distinguished and classed them, although he knew nothing of their microscopic appearance. He has appropriated the true Saxony wool to the making of the finest cloth—he has availed himself of its superior felting quality; and he is using the Australian wool for the better combing purposes, in which a strong tough wool, soft and long in the staple, is useful.

The wool is packed in bales, wrapped in canvass, and forwarded to Sydney, where it is sorted by the merchants, and repacked for exportation; but some of the larger sheep-farmers send their wool direct to their agents in London.

Sheep-farming now constitutes the chief employment and dependence of the New South Wales colonist. Some of these persons possess 15,000 or 20,000 sheep. These are divided into separate flocks, more or less numerous, according to the nature of the country and the pastures. Where the land is literally plain and cleared of timber, a thousand sheep are sometimes put under the charge of one shepherd and his dogs. Where there is much wood or irregularity of surface, 350 sheep are deemed quite as many as one shepherd can properly take care of. The sheep are led out to graze before sunrise, and folded, or brought back to the sheep-yard at night, but they are never housed. This is very different from the treatment of the Saxon sheep, with which they are now, and not altogether unsuccessfully, competing.

The work of the shepherd—usually a convict—is therefore very severe, especially in the more sterile parts of the colony, where three acres of the uncultivated ground are scarcely sufficient for the support of one sheep.

The principal enemies that the sheep have to fear are the wild dogs, which are numerous in some parts of the country, and will sometimes attack the flock in the open day. The wall of the sheep-yard is too high for them to overleap at night; and the hurdles for the fold are made of light swamp oak, or slight iron rods seven feet in length, which are placed so close that the lambs cannot escape, nor the dogs enter. A watchman, with his dogs, has a moveable weather-tight box, in which he passes the night close by the fold, and near to which he kindles a fire, as well for his own comfort, as to scare away the wild dogs *.

There is another more crafty and dangerous foe in the runaway convict, who, in the interior and wilder parts of the colony, has his retreat usually well stored with the mutton stolen from the neighbouring flocks.

The pernicious system of breeding too early is general; and it is not an uncommon occurrence to see a ewe, not a twelvemonth old, with a lamb at her feet, and the mother and her progeny, of course, half starved †. The old and toothless wethers and ewes are seldom draughted from the flock, on account of the false impression, that, as the animal grows old, the wool becomes more valuable. It may be finer, but it is a sickly thinness of fibre which it acquires, and it has lost the greater part of its original soundness. These poor animals are suffered to crawl after the flock, until they are worn out with age and infirmity.

The ewes are put to the ram in January, the midst of the summer in New South Wales. The reader scarcely needs to be informed that the

* Cunningham's Two Years in New South Wales, vol. i. p. 251.—Lang's Historical and Statistical Account, vol. i. p. 349.

† Widowson's Van Diemen's Land.

seasons are reversed in that part of the world. The spring commences in September, the summer in December, the autumn in March, and the winter in June. The lambs are therefore dropped about the middle of the mild winter of that colony, and are ready for the first flush of the grass in the spring *. There is, however, some variation in this: a few of the sheep-masters contrive that the lambing season shall be at the beginning of summer †; and others, more absurdly, endeavour to procure two sets of lambs in one year, or at least in fourteen months ‡.

The sheep in New South Wales appear to be nearly exempt from most of the maladies to which these animals are exposed in Europe; but to the *foot-rot* they are lamentably subject. Although there is a general complaint of want of water, and there are, occasionally, long seasons of drought, yet the sheep frequently suffer from the wild and poachy nature of a considerable portion of the pasture. The foot-rot seems to assume a character of its own in New South Wales. In an early stage it is easily managed, if the knife and the caustic—the butyr of antimony far beyond all other caustics—are skilfully applied; but if neglected, it speedily becomes inveterate, and preys upon and destroys the animal. The losses occasioned by it in the early existence of the colony were frightful.

Next in order, whether the frequency or serious results of the disease are considered, stands "the scab." This too is manageable in an early stage. An ointment, composed of one part of strong mercurial ointment, and five of lard, well rubbed together, will speedily get rid of it; but if it is neglected in the early stage, the irritation which it occasions wears out the animal.

Dr. Lang says, that "when a convict-shepherd has a pique against his master, or even against his overseer, it is often in his power to subject the whole of his master's flock to this obnoxious disease, merely by driving his own flock a few miles from their usual pasture, and bringing them into contact with a diseased flock." He well remarks that "the chief source of the wealth and prosperity of the colony is thus, in a great measure, at the mercy of the most worthless of men §."

### WESTERN AND SOUTHERN AUSTRALIA.

Stimulated by the success of the colony on the eastern coast of New Holland, another has been established on the western coast. It takes its name from the river—the Swan River—on the banks of which its principal settlement was placed. The main hope of these colonists likewise depends on the successful cultivation of sheep; and though the establishment is yet in an infant state, some fine samples of wool have already found their way to the British market. One of its advantages, so far as they can be at present ascertained, is the evident superiority of the soil. In some parts of the colony on the eastern coast, it has been stated that three acres of land are scarcely sufficient for the keep of one sheep; but, in almost the whole of the country on the banks of the Swan River, two or three sheep may be kept on every acre. It is also said, that on the western coast a settler can much more quickly and perfectly bring his farm into a state of cultivation, on account of the more open state of the country; and not only on the banks of the main river, but in the inland country there is plenty of water ||. Time will determine the relative value of these colonies.

On the southern coast of New Holland, a third colony has lately been established, under the title of "Southern Australia," and extending from

* Widowson's Van Diemen's Land. † Lang's Historical Account, vol. i. p. 348.
‡ Widowson's Van Diemen's Land. § Lang's Historical Account, vol. i. p. 351.
|| Fraser's Picture of Australia, p. 325.

Fowler's Bay to Cape Northumberland, but there has not yet been sufficient time for it to work.

### THE VAN DIEMEN'S LAND SHEEP.

Separated from the southern promontory of New Holland by a narrow strait is Van Diemen's Land, so called from the name of the governor-general presiding over the Dutch settlements in the East Indies when the island was discovered. The British government, observing the success of the colony at Sydney, resolved to form a new establishment on the southern coast of New Holland, to which the worst description of the convicts from England might be sent, and also those who had been guilty of serious offences at Port Jackson. Two ships sailed from England in the spring of 1805 for this purpose. Their destination was Port Philip, which they reached in the autumn of the same year; but it was speedily found that the want of water and other circumstances would render it impossible for a permanent colony to be established there, and the vessels proceeded to the mouth of the river Derwent, in Van Diemen's Island. This situation seemed to be peculiarly eligible, and the capital of the new settlement, Hobart Town, was soon afterwards built.

The climate of Van Diemen's Land is much more temperate than that of New South Wales. It is equally free from the occasional drought of New Holland, and the humidity of the mother country*.

In 1807 sheep were first introduced there. They came from India, and from Norfolk Island, and were of the same character as those that had been formerly conveyed to New South Wales. Afterwards, Colonel Paterson, who had established himself more on the north of the island, imported some of the Teeswater sheep; but the progress of improvement was slower in Van Diemen's Land than in New Holland; and the settlers were often exceedingly annoyed by gangs of bush-rangers, or runaway convicts.

It was not until after the year 1820 that the cultivation of fine wool may be said to have been established there. Lieutenant-General Sorrell, who was governor of the colony, entered into an arrangement with Capt. M'Arthur, who agreed to part with 300 Merino lambs, for the use of the colony at Van Diemen's Land. They were sent to Sydney, and embarked on board a government vessel; but, the ship being detained a considerable period at Sydney, a distemper broke out among them, and ninety-one died there and on the passage, and twenty-eight more were lost soon after they were landed; so that only 181 of them remained. These were valued at seven guineas each; and in September, 1820, were distributed among the settlers in the neighbourhood of Hobart Town, in proportions regulated by the governor, and depending on his opinion of the agricultural skill and trustworthiness of the colonists. No money was demanded at the time; but security was given for the payment of the sum, at a certain after-period, when the settlers might have begun to have reaped the advantage of the speculation†.

Some years afterwards, Mr. Gilles of Merton Vale did more benefit to the colony than all the united attempts of the older settlers, by introducing the pure Saxon breed direct from Germany‡. The competition between the two colonies now commenced; and whether it was that the Van Diemen's Land settlers were so much later in the field, or the climate of that island is not so favourable to the growth of fine wool, the fleece does

* Widowson's Van Diemen's Land.
† Bischoff's History of Van Diemen's Land, p. 44.—Biggs's Report, Jan. 1823.
‡ Widowson's Van Diemen's Land, p. 143.

not fetch so high a price in the market as that from the sheep of New South Wales.

The following is a cut of some lamb's wool from Van Diemen's Land. It is inserted not only to afford idea of the nature of the wool grown there, but on account of its great singularity.

*Van Diemen's Land Lamb's Wool.*

1.

2.

1. *A fibre of it viewed as a transparent object.*
2. *Ditto as an opaque object.*

When viewed as a transparent object (1.), its diameter was about $\frac{1}{750}$th part of an inch, and its serrations were slight, in some places indistinct and very irregular. It had more the appearance of a combed wool than of the natural fibre.

As an opaque object (2.), it was difficult to assign any distinct character to it. After long and almost painful observation, the cups could be distinguished, but the fibre seemed to be enveloped in a woolly exterior, which gave it the character of a vegetable substance in a state of decomposition. How this may tally with its use the manufacturer must determine.

The quantity of wool imported from Van Diemen's Land has rapidly increased. In 1827, 192,075 lbs. were shipped for England; in 1828, 528,845 lbs.; in 1829, 925,320 lbs.; in 1830, 993,979 lbs.; in 1831, 1,359,203 lbs.; in 1832, 951,131 lbs.; and in 1833, 1,547,201 lbs.*.

Of the number of sheep at Van Diemen's Land, it is impossible to form a calculation. There are probably between 700,000 and 800,000; but the embarrassment of many of the settlers, and the wish to swell the amount of their property, as well as to entitle themselves to a share of the supply required for the King's stores, all operate to give a delusive character to their returns. In the amount of the wool imported into England, there can, however, be no mistake †. The number of sheep belonging to the Van Diemen's Land Company, and whose accounts were accurately kept, in 1810, were only 3070, but they had increased in 1821 to 170,391. They were multiplied sixty-fold in eleven years‡.

The system of sheep-management is nearly the same, except that the flocks are smaller. Mr. Widowson is of opinion that not more than 300 should run in one flock. "I have frequently watched," says he, "a flock of sheep of a thousand feeding, or rather trying to feed; the wethers, or strongest ewes, always leading the flock, rushing on continually before the rest, and leaving the weaker ewes to browse on the grass they have soiled." There are a greater portion of hired shepherds and other servants at Van Diemen's Land than at New South Wales §.

* Bischoff's Van Diemen's Land, p. 50.—M'Culloch's Dictionary, art. Wool.

† Bischoff's Van Diemen's Land, p. 42.

‡ Widowson's Van Diemen's Land, p. 103. Bischoff calculates the live stock in Van Dieman's Land to have consisted, in 1830, of 665,000 sheep, 113,000 cattle, 2805 horses, and 1090 goats.

§ Widowson gives a curious account of the frequent mode of hiring the shepherds. He says that "a young man going out with letters of recommendation from the clergyman of the parish, or some influential person, will generally find employment soon. Sheep are intrusted to him on *the thirds* by those who are the proprietors of many flocks; or whose other engagements will not allow them to give personal attention to their sheep. The arrangement generally entered into is this:—A. agrees to give B. 400 ewes on *the*

The general system of management is the same as in New South Wales, except that the baneful practice of suffering the ewes to breed twice in fourteen months is more generally followed.

The sheep are even less subject to disease in Van Diemen's Land than in New South Wales; and the foot-rot, which is so destructive in the latter, is scarcely heard of in the former. The system of raising artificial food has been introduced into Van Diemen's Land, but not to so great an extent as at Port Jackson, because the soil is more productive, and there is a greater quantity of natural herbage in every season of the year.

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## Chapter VI.

### A CHRONOLOGICAL HISTORY OF THE BRITISH SHEEP AND WOOLLEN MANUFACTURES.

Some writers have doubted whether the sheep is indigenous to Britain. They state that the old natural historians, and the writers on agricultural subjects, who describe the various kinds of sheep in Asia and in Europe, make no mention of these animals as existing in Britain *. The natural reply to this would be, that they are equally silent as to the sheep of the greater number of the uncultivated people of these times; and that if it is to be concluded that an ancient and rude nation was not possessed of certain animals, or certain conveniences of life, because these things are not mentioned by the historians of that day, a very erroneous estimate would be formed of their comforts, habits, and occupations.

It is also said that the trading of the Phœnicians with the Britons in lead and tin is recorded by several writers, but that there is no mention of sheep or wool as articles of commerce. The answer to this would be, that these early voyagers traded with the inhabitants of the remote west for those commodities alone which their own country, or the countries bordering upon them, did not produce; and that Phœnicia was in the neighbourhood of the districts inhabited by the primitive flocks, where the sheep and wool were most cultivated, and in the highest perfection. It was not likely that they would pay much attention to an article then little cultivated in Britain, because little used, and of the real value of which they had not the means of judging. It is, however, mentioned, that the skins of animals—the oldest species of barter, and practised in the very dawn of society—did form a part of their commerce; and it is not improbable that the skins of sheep constituted a portion of the freight †.

The Britons, in that early time, were sailors. They had little canoes in which they explored the creeks and harbours of their indented coast. These boats or coracles were made of wicker-work, that they might live where heavier vessels would be in danger of being dashed to pieces; and

*thirds;* A. providing rams also, which are his individual property. B. becomes responsible for the original number of sheep, excepting such as are lost by disease or accident. At the time agreed on the produce is divided, and one-third of the lambs becomes the property of B. Generally speaking, the party to which the flock belongs prefers the wether lambs; but as it is very much to the advantage of the other party to procure as many females as he can as the foundation of his own future flock, this arrangement is not objected to."

* *Chronicon Rusticum Commerciale;* or a History of British Wool, by John Smith, *passim.* This work, although not without its faults, is exceedingly valuable, and may be generally depended upon, except in the very early part of his history.

† Maurice's Commerce of the Britons, in his Indian Antiquities, p. 302.

the wicker-work was covered with the skins of animals that had undergone some process of tanning, and that varied in size and weight, and had probably been taken from different subjects, according to the capacity of the boat *.

The reed-built huts of the Britons were likewise covered with skins similarly prepared.

It is true that Cæsar, who describes the habits and manner of life of the Britons very circumstantially, makes no mention of the sheep, or of the employment of its wool as connected with any article of clothing; and therefore Speed gives it as his opinion, in his "Chronicles," that "the use of the wool detached from the sheep was quite unknown to the Britons, who, when they were clothed at all, were clothed only in skins.†" It is well known, however, that at that period the Gauls, between whom and the Britons there was much intercourse, and whose habits were much alike, possessed the art of manufacturing a kind of cloth or felt, without spinning or weaving, sufficiently strong to resist the stroke of a sword.

It was only when engaged in war that the Britons went almost naked, and painted and punctured their bodies in order to terrify their foes. When at home and at peace, they were clothed with the skins of beasts, and lived upon milk and flesh. Milk was one of the earliest articles of food in every ancient and uncivilized tribe; and the use of the milk of the sheep preceded that obtained from cattle by very many centuries in all these hordes. Therefore, and as no historian mentions the introduction of the sheep into Britain, it is probable that it existed in that island from a very early period; and in that state of domestication in which it was found among other nations long before the subjugation of the ox ‡.

In the year fifty-five before Christ, Cæsar first landed on the coast of Britain; but it was not until more than a century afterwards that this island could be said to be completely subdued under Agricola.

The conquest of the island being effected, the Romans, as in every country in which their arms prevailed, directed their attention to the civilization and improvement of their new subjects, and, among other things, they established a woollen manufactory at Winchester. Whence came the material? Was it furnished by the flocks of Italy or of Spain? Historians say nothing of this; nor was the commerce of the Romans sufficiently advanced to enable them to bring from a distance a sufficient supply of wool.

No historian makes mention of the importation of sheep into the British islands by its conquerors; although that would have been a boon which many a writer would have celebrated. No! the factory was supplied from a native source; from that fleece, the value of which the uncultivated

* See Maurice, as before.

† It is curious to trace the predilection to the use of skins even to modern times. George Fox, the quaker, in the reign of Charles I., is said to have travelled in his apostolic missions, buttoned up in a leathern doublet or waistcoat with sleeves, and which supplied the place of a coat. The common dress of the labouring mechanic, not a century ago, consisted of this leathern doublet; and the buckskin breeches of the sportsman are still worn.

‡ Hardyng, in his Chronicles, seems to illustrate this. He is describing the daughters of Danaus, when they first landed in Britain. Albyne, the eldest daughter, gives to her sisters

"arrows and boltes,
To slee the *dere*, the *bull*, also the *bore*,
The bear, and byrdes that were therein before.

And they, "with pitfalles and trappes, begil the beastes, and byrdes, and fyshe to their sustenance." Nothing, however, is said of the sheep; he was already a domesticated animal, when all the rest were wild.

Britons, clothed only with skins, had not discovered, but which was at once manifest to their conquerors.

It was, doubtless, principally established for the supply of the Roman army with clothing; but it was not long confined to this. Some of the fabrics reached Rome; and they were so highly appreciated, that during the continuance of the Roman domination, and in the most luxurious era of the empire, the finest and most expensive robes—those used only on days of festivity or ceremony—were furnished by the British factories. One Roman writer, Dionysius Alexandrinus, uses the following language, as quoted by Hollinshed, and strongly expressive of the value of the material: "The wool of Britain is often spun so fine, that it is in a manner comparable to the spider's thread *."

It would be pleasing to know what kind of British wool was used in the first manufactory, although this would not decide the question as to the primitive breed, nor whether there was any breed to which this distinctive name could be applied. Possibly, as now, there were different breeds, suited to the soil and produce of different districts. The account just given of the material has been said by some persons to leave little doubt as to the breed that was first selected. "The wool was spun so fine as to be in a manner comparable to the spider's web." It was the long wool, that which, at the present day, as fifteen hundred years ago, stands unrivalled in the world as a combing and spinning wool; and it has been added, that, as old usages are not often forgotten, and old-established manufactories do not often change their fabric, there are still many factories of fine worsteds in the immediate neighbourhood of Winchester, and that can scarcely be excelled in the kingdom. The situation of the first factory leads, however, to a different conclusion. Winchester is in the very heart of the short-woolled country, a country, in fact, that would support no other breed of sheep. It is surrounded by the Westdown sheep; it has the Dorsets on the west, the Wiltshires on the north, and the Southdowns of Sussex on the east. The short wool was the only material that could be procured without difficulty there, or that could be procured at all. It was the short wool that was used in this first manufactory, and, the art of fulling not being carried to the perfection to which it now is, the threads were plainly seen, and their comparative fineness could be ascertained. It may be added that factories of short woollen goods have been established there from time immemorial, and that the first guild of *Fullers* was chartered at Winchester.

Whether other manufactories arose, or how long this maintained its high reputation (it never became defunct), or what change, and how soon, was effected in the clothing of the natives, or the cultivation of the sheep, are subjects with respect to which history is silent. A chasm, unexampled in the records of any other country, succeeds. In the distractions to which Britain was subject for 600 years, it may well be supposed that the art of manufacturing cloth, like every thing else, fell into comparative decay. It was not, however—it never could be—altogether lost. Notwithstanding the general inattention of our early writers to the state or the progress of the useful arts, we are still able to collect a few scattered hints, which lead to the conclusion that the preparation of wool for its manufacture had become, in very early times, a favourite employment of the Britons, both in the higher and inferior situations of life; and that the superiority of the wool, and of the fabric procured from it, was perfectly appreciated, and considered as the foundation of our national prosperity †.

It is not, however, until the year 712, that, after the expulsion, or retire-

* See Anderson on Commerce, vol. i.

† Appendix, No. 4, to the Report of the Highland Society, p. 30.

ment of the Romans, the sheep is expressly mentioned; and then it is merely stated that the price of the animal was one shilling until fourteen nights after Easter*. This shilling of Saxon money was about equal to five pence of the present currency, there being forty-eight Saxon shillings in the pound; and, taking into account the different value of money, and the different expense of living, would be equivalent to twenty times that sum, at the present day.

Another interval of 160 years passes, and then the mother of the noble Alfred is described as being skilled in the spinning of wool herself, and busied in training her daughters to the same employment †.

It is generally believed—and the ground on which the statement rests is somewhat more certain than the propensity to attribute to this patriot-monarch every thing that is dear to us as Britons—that, among the various arts which he encouraged, the woollen manufacture stood one of the foremost.

Forty years afterwards, we have another pleasing picture of the domestic arrangements of some at least of the higher classes, and the universal attention to the uses and manufacture of wool. Edward the Elder died. He had children by three wives, the first of whom was named Egwina, and was a shepherd's daughter. Speed explains this. She was the daughter of a gentleman, perhaps a country gentleman, but not a soldier, and therefore, in the language of the court, called a shepherd. They who were not devoted to a military life were supposed to be employed in the breeding of sheep. Here is a satisfactory illustration of the general attention which was now paid to this branch of husbandry—this source of national wealth ‡. Smith adds, that we are not to measure the grandeur or delicacy of the court of that day by present appearances and manners, for, in Fabian's Chronicle, p. 179, it is remarked of this same King Edward, that, being careful that his children should receive a proper princely education, "He sette his sons to scole, and his doughters he set to woll werke, taking example of Charles the Conquesterer."

The very name by which unmarried women in England are designated —spinsters—is a proof at once of the antiquity and universality of this mode of employing time; and also of the extent to which the sheep was cultivated, for the flocks must have been numerous and large, to have given employment "to the unmarried women of all classes," as Bayley has it in his Dictionary, "from the daughter of a prince to the meanest person."

* Stillingfleet's Chronicon Pretiosum, p. 50.

† Alfred, if the Chronicle of Robert of Gloucester is to be believed, had reason to love and reverence her.

"King Alfred was the wysest king that long was byvore;
Lawes he made—right all ones, and strongore than er were.
Clerc he was, God yknow, and yet as one telleth me,
He was not lesse than ten yere old er he couthe ys abece.
And his gode mether ofte smal gyftes to him she kindly toke,
Vor to leve other plé, and loke upon his boke."

Gentleman's Mag. 1834, p. 596.

The story on which these monkish rhymes are founded, is thus related by Asser. "Though he had reached the age of twelve before he acquired an art then so rare as that of reading, he was delighted with listening to the Anglo-Saxon songs. Judith, his mother, holding in her hands a volume of these poems, in which the beautiful characters pleased her husband's children, said to them, 'I will give it to the one among you who first learns to read it.' 'Will you?' eagerly asked Alfred, although the youngest. 'Yes,' said she, with a smile of pleasure. He suddenly snatched the volume out of her hands, and running to a schoolmaster, returned no more to his home until he was able to read and recite it to her."—Mackintosh's History of England, vol. i. p. 37.

‡ Chronicon Rusticum.

The antiquity of the word is beyond the limit of any record or traditional account of its origin *.

The bones of many wild animals have been discovered in various parts of England; and soon after this time, it appears that the country was overrun with wolves. The civil wars, and foreign invasions which so rapidly succeeded to each other after the death of Alfred, engrossed the whole attention and care of the people; and the vigour of the West Saxon government expiring with Athelstan, the son of Alfred, these ferocious beasts were suffered to multiply so fast, that travelling, at least in the night, became dangerous; and houses were erected in the midst of some of the forests, in which the traveller might rest in safety until the morning—although, as in other countries infested by wolves, there can be no doubt that proper means were taken, in the form of sheep-yards and folds, and the courage and fidelity of the British dog, even then celebrated in distant countries, in order to protect the sheep during the night. The wolves were probably the source of much annoyance and loss to the sheep-breeders. Twenty years afterwards, however, the warlike Edgar, having obtained possession of the whole of the Anglo-Saxon country, determined to extirpate these quadruped foes. His plan was a politic and a successful one. He commuted a portion of the tribute for a certain number of wolves' heads, and, before three years had expired, not one of these animals remained in the whole of his dominions †.

It would be imagined that the cultivation of the sheep, and the progress of the woollen manufacture, would meet with no farther hinderance; and, from notices which occur a great many years afterwards, there is reason to conclude that much attention was bestowed on them, and that they were fully recognized as the sources whence the monarch drew a considerable portion of his tribute, and the foundation of the general prosperity and wealth of the kingdom. The historians of those days, however, had more marvellous things to occupy their attention.

De Witt, the Grand Pensionary of Holland, states, that about the year 960, or somewhat earlier, the woollen manufactory was established in Flanders. He says, that "the Flemings lying nearest to France were the first to earn their living by weaving. Baldwin III. assisted in this by appointing certain fairs, or markets, where the material and the manufactured fabric might be bought and sold free of duty. Some sort of woollen cloth must have been made in all countries emerged from barbarism." There is considerable doubt, however, whether the Flemings at this time—eminent as they afterwards were for their manufactures—were any thing more than merchants ‡.

The price of the sheep remained unaltered; for, in 1000, in the reign

* Report of the Highland Society, App. No. 4, p. 50.

"To spin with art in ancient times was seen,
Thought not beneath the noble dame or queen;
From that employ our maidens took the name
Of spinsters, which the moderns never claim."

Brit. Farmer's Magazine, 1830, p. 436.

† They were still occasionally found in the mountains of Wales; and the last was destroyed in Scotland in 1680, by Sir Edward Cameron of Lochiel.

Fynes Morrison, in his Itinerary, mentions the depredations committed on cattle in Ireland by the wolves. In the winter nights they sometimes entered the villages and the suburbs of the cities. This continued until the beginning of the eighteenth century. It is said that the last wolf seen in Ulster was shot by Arthur Upton of Aughnabreack, on the Wolf-hill, near Belfast; and the last of these animals seen in Ireland was killed in 1710, in Kerry, on the Crony River, near Glenarm.—Gentleman's Magazine, 1834, p. 149.

‡ Anderson on Commerce, i. 46.

of Ethelred, it was determined that, if a sheep was accidentally or wilfully destroyed, the compensation should be one shilling of Saxon money *.

In 1041, at the accession of Edward the Confessor, a pestilential epidemic prevailed among cattle and sheep, which destroyed the greater part of them. The supposed cause of it is not stated †.

Another and even more destructive one occurred in 1125, in the reign of Henry I., and which also swept away many thousand human beings ‡.

In the early days of the Norman kings, when woollen manufactories were established in many parts of the kingdom, the cloth was made of British wool alone, and which was then highly esteemed for its fineness and clothing quality. The short wool therefore was in extensive requisition, for of that alone could these broad cloths be made, and the long wools were employed for hosiery and woollen goods. The value of both breeds of British sheep was now understood and acknowledged.

These cloths were also dyed of various colours, and in a very superior way.

The price of the sheep remained unaltered for a considerable time. In the year 1100, at the accession of Henry I. to the throne, and when he wanted money to enable him to resist the juster pretensions of his brother Robert, he offered to take a portion of his tribute in kind, and a sheep or a ram was reckoned at about 13*s*. of the present value of money. Many years afterwards, and towards the close of his reign, when this system of paying the taxes in kind seemed to be established, forty sheep were equivalent to as many pounds; or the price of the sheep had risen to 20*s*. §; and fifty years after that, in the reign of Henry II., the price had risen to 25*s*. (present value), for the tenants of Shinborn (Sherborne) were each compelled to pay that sum or a ram towards the support of the church ‖.

In 1140, the fifth of King Stephen, the woollen manufactory was in so flourishing a state in many of the large towns, that the merchants petitioned the King for power to form themselves into distinct corporations or *guilds*, governed by such regulations and laws as they might deem expedient for the especial protection and furtherance of their trade. It comes not within the scope of the present work to inquire into the policy or the justice of these combinations. In many cases, and especially in an early and comparatively rude state of society, they might be productive of advantage to that particular trade whose members were combined together; but they were easily made the engines of monopoly and oppression. The difficulties which the members of these guilds threw around an admission into their fraternity—the fees they exacted—the power they frequently exerted of preventing all who did not belong to their company from engaging in the same business, at least in the neighbourhood of the guild—and the long

* There is a curious record as to the comparative value of the different domestic animals at that period. By an agreement between Ethelred's commissioners and those of Wales, it was arranged that the value of strayed cattle should be thus computed:—A horse, 30 shillings, or 150 pence, there being at that time 5 pence to the shilling; an ox, 30 pence, or 5 shillings, being only one-sixth of the value of a horse; a swine, eightpence; a sheep, one shilling, or 5 pence, and a goat, 2 pence.—Anderson on Commerce, i. 99.

It has been calculated that the price of these things, or the expense of living, was then only as 1 to 20, supposing that the value of money at this late period of the Saxon domination was the same as under the first Norman monarchs. It is also observed, that the sheep, whether compared with the ox or the swine, is proportionally dearer than either of them. This circumstance is easily accounted for when the value of the fleece is recollected, and which had been devoted to manufacturing purposes.

† Chronic. Saxonic. An. 1041.

‡ Chronic. Saxonic. An. 1125.

§ Chronicon Rusticum, in loc.

‖ Chronicon Rusticum, in loc.; and Stillingfleet's Chron. Pretiosum, do.

and expensive apprenticeships which were required—might be, and often were, exhibitions of cruelty and tyranny, such as the monarch himself scarcely dared to attempt. As the true principles of trade became better known and practised, the power of these guilds was curtailed. Many of them gradually became social and charitable, instead of political bodies; and the time will arrive when they will no longer be permitted to possess any special immunities that tend to obstruct a free competition in business*.

The manufactory originally established in Winchester still flourished, although eight or nine hundred years had now passed away; for it is said that the weavers of wool paid "one mark of gold (2*l.*) annually, equal to 30*l.* at present, to have their customs and liberties, and right to elect the aldermen of their guild †."

Had there been any doubt that the manufacture of the short clothing wool was that which was originally established, it would now have been cleared up; for it is added that the *fullers* of Winchester, the birth-place of the manufacture of wool in Britain, likewise applied to be elected into a separate guild, for which they paid 16*l.*, at least equal to 240*l.* at the present day, annually ‡. The British short-woolled sheep are no animals of yesterday's importation; but, from the earliest period in the history of the commerce of the island, are intimately connected with the national prosperity.

It appears that, at the same time, the cloth manufactory existed and flourished in other parts of the kingdom, for the weavers of Oxford paid a mark of gold for their guild, and the weavers of London 16*l.*

Were other proof wanting of the flourishing state of the woollen manufactory at this period, it might be added, that in the same year, 1140, "the men of Worcester pay 100 shillings, (equivalent to 50*l.* of the present money,) that they might buy and sell again wool, as they were wont to do in the time of Henry I. §" It appears from other circumstances, that this was all British, and not foreign cloth; and the quantity must have been very great, when the dyers of one town, and that of no great magnitude, could afford to pay such a sum for the recovery of a lost privilege of this nature.

In the records of the Exchequer for 1150, there is an opportunity of comparing the opulence or estimation of the guild of woollen manufacturers with that of another trade. The annual tribute of the guild of the weavers of London is lowered to 12*l.* (180*l.*); and that of the *bakers* of the same city—a numerous body, as providing the principal article of food—was set at 6*l.* (90*l.*) ‖.

The woollen manufacture must have been extensive and valuable, and conducted on scientific principles, when divided into these distinct departments; and the subordinate one attaining to such a magnitude as to be elected into a separate guild.

In 1172, a circumstance of much importance in the history of the British woollen manufacture, and which has already been alluded to, occurred. Henry II. expressly ordained by statute, that Spanish wool should not be mixed with English wool in the making of cloth—broad cloth and that of a fine quality ¶. One object of this enactment probably was, that the importation of foreign wool should not lower the price of that of native growth, and thus interfere with the interests of the British sheep-master. It was the first of those absurd prohibitions which more correct views of

* See some excellent observations on these chartered bodies in M'Culloch's Dict., Art. Corporations.

† Madox's History of the Exchequer, p. 332.

‡ Do. § Do. p. 286. ‖ Do., p. 250.

¶ Anderson's History of Commerce, p. 189.

commercial and national policy have banished for ever. Anderson says, that "the use of Spanish wool was prohibited lest it should have debased the British manufacture." This is a point for the consideration of which the reader is scarcely yet prepared; but at all events, this fact is established, that in the twelfth century, and from the fleece of the British sheep alone, a cloth was made—a broad cloth, of a sufficiently fine quality to give general satisfaction. Thus much, however, may at present be affirmed, that although the British wool, some centuries afterwards, when, amidst the contentions of the rival houses, and the narrow policy of successive monarchs, the true interests of the country were abandoned—sacrificed—was inferior to some of foreign growth, and particularly to the Spanish, and the woollen manufactory was comparatively lost in Britain, yet the weight of evidence is favourable to the conclusion that, in earlier times, it would not yield to any that the continental states could produce. As the history of the woollen manufacture proceeds, there will be additional reason for believing this.

In 1186 the prohibition of Spanish wool was more strictly enforced, and it was ordered, that all cloth of British manufacture that should be found made of Spanish wool, or in which that material should be mixed, should be burned in the presence of the Mayor of London *.

Three years after this, (1189,) Richard Cœur de Lion succeeded to the throne. He embarked in the expedition to Palestine, and was treacherously imprisoned by the Duke of Austria on his return; and he could not obtain his release until he had engaged to pay an exorbitant ransom. As a means of raising the stipulated sum, the plate of all the churches and monasteries was taken, and those orders, who agreeably to their vow of poverty, had no plate, were compelled to contribute one year's wool †. The conclusions to be drawn from this are, that the lands of the religious houses were employed in the growth of wool; that this commodity constituted, next to the plate which was so lavishly displayed around their altars, their principal wealth; and that it was a good merchantable commodity: in fine, that, in easy and immediate application, it stood next to money, and was therefore selected for a purpose like this, which admitted of no delay.

Near the close of this century, another circumstance occurs, which proves the increasing cultivation and value of wool—enough is grown, not only to supply the wants of the native manufacturer, but it begins to find a market abroad. It would seem that its exportation had hitherto not been legalized, or, in fact, had been prohibited; for the History of the Exchequer relates, that in 1128, "the chamberlain of London accounted for 23*l.* 12*s.*, (equivalent to 472*l.* at present,) the fines of merchants for leave to export wool and leather; and 20*l.* (400*l.* present value,) for the sale of wool belonging to William de Boulogne, and which, being attempted to be exported without license, was forfeited ‡. There is no doubt, however, that the occasional exportation of wool had existed almost two centuries.

It also appears, that this contraband exportation was carried to so great an extent, that the government took into consideration the question of legally sanctioning it, and which, on account of the narrow and illiberal notions respecting trade which then prevailed, would not have been for a moment mooted, had not the British market been completely glutted with the commodity. The attempt at illegal exportation, and the amount of the fine for the wool seized, sufficiently prove the overflow at home, and the value of the article abroad. A seizure was made at Hull, in this year, the proceedings on which discover the actual price of wool in the English

* Kennedy's Tenancy of Land, vol. ii. p. 351.

† Rapin, p. 254.

‡ Madox's Hist. of the Exchequer, i. 776.

market at that time. The penalty was estimated at 5 marks—3*l.* 6*s.* 8*d.*, the silver mark being 13*s.* 4*d.*—per sack of 26 stone, (or 364 lbs.) which is a little more than 2*s.* 6*d.* (50*s.*) per stone, or almost 3*s.* 6*d.* per pound —an enormous sum, and decisive as to the value of the article at that early period.

In the following year another parcel was seized at the same port. The owner not choosing to pay the estimated value, it was sold by public auction, at 2½*d.* (3*s.* 9*d.* present value) per pound *.

These scattered facts, thus collected together, incontestably prove that at a far earlier period than has been generally imagined, or few of the English historians acknowledge, the cultivation and the manufacture of wool were not only established, but flourished in Great Britain. From the time when the British cloths were accounted unrivalled at the luxurious metropolis of the world, to the period to which the present sketch has reached, the breeding of the sheep, and the manufacture of its fleece constituted the chief employment and wealth of the country.

During the reign of Henry I. several Flemings, driven from their own country by a dreadful inundation, settled in England. They were hospitably received, but it is far from certain that they contributed much to the improvement of British manufacture; for, as will presently be seen, the inhabitants of the Low Countries were never growers of wool to any considerable extent, but their trade was founded on the importation of the material from other parts, which was now only commencing, and the facilities which that importation afforded.

If to the Roman conqueror Britain was indebted for this inexhaustible source of prosperity and wealth, she cherished and perpetuated, and, doubtless, improved it. But a different era now succeeded. To the contentions between John and his Barons followed other disputes and bloody feuds; intermingled with foreign wars when there was a moment's peace at home: and from the frequency of royal exaction, and of brutal outrage, property and every commercial pursuit became so insecure, and almost valueless, that, if the cultivation of the sheep continued, it was not with its former spirit and success, the manufacture of the fleece was comparatively abandoned. Sir Matthew Hale says, that "in the time of Henry II. and Richard, this kingdom greatly flourished in the manufacture of cloth; but by the troublesome wars in the time of King John and Henry III., and also of Edward I. and II., this manufacture was wholly lost, and all our trades ran in wools and woolfells, and leather †."

Our historians, however, have taken this assertion of the learned Chief Justice somewhat too literally. There is no doubt that the English trade materially changed its character; and that the notices of wool, which for more than a century from this time occur, have chief reference to the various artifices by which the royal coffers were filled under the pretext of licence or of fine. It is also probable that the insecurity of property, and the numerous instances of capricious tyranny which disgraced this era of

* In estimating the present value of the different sums of money of which mention has been made, the following calculation has been adopted:—the silver shilling hitherto, and for some centuries after this, weighed three times as much as it now does; and, on account of the scarcity of money, the expense of living varied from one-fifth to one-eighth of what it does at the existing period. The real proportion was continually varying; but in order to avoid exaggeration, and to arrive at an even sum, 6⅔ was assumed as the general average, and this multiplied by three gave twenty; or, in other words, the value of a certain sum then was equal to twenty times as much at the present day. From the increasing quantity of the circulating medium, soon after this period the difference in the expense of living decreased to the average of five; and therefore, and for some centuries to come, the multiplier will be fifteen instead of twenty.

† Primitive Origin of Mankind, p. 162.

the dawn of British liberty, might have driven many of the artisans in wool to other countries. The Low Countries, in particular, might have materially benefited; and it is not improbable that the Netherlands were considerably indebted to Britain for the early establishment of the woollen manufacture among them; although in after years—in the reign of the third Edward—that benefit was returned by the revival of the lost British manufactures through the instrumentality of the Flemings. Many hints, however, of the continuance of the woollen manufacture in England during those troublous times, although in a comparatively depressed state, will occur, as the history of the British sheep is pursued.

In the third year of John, there is a confirmation, in the prosperity of an individual, of an inferior branch of the woollen trade, that its depreciation had only just commenced:—

"An. 1201, David the Dyer pays one mark of gold (2*l.*, equivalent to 30*l.* now) that his manor might be made a burgage *."

As a further proof, if it were wanted, the record of the *custom* or duty paid on the importation of woad—one of the articles used in dyeing—is preserved. It is valuable, not only as showing the almost incredible extent to which the woollen trade has been carried, but the places where the manufactories were principally established. Essex paid, (in 1213,) according to the estimated value at the present time, 121*l.*; London, 540*l.*; Norfolk and Suffolk, 1650*l.*; Southampton, (the port of Winchester,) 2230*l.*; Yorkshire, 3090*l.*; and Kent and Sussex, 3200*l.* † It is pleasing to see the town whence the manufacture derived its birth, still maintaining so high a rank among the rival districts.

In the preceding year, in order for the easier adjustment and collection of the duties on manufactured goods, it was arbitrarily determined that all the better and dyed cloths should be of the same width: i. e. "for dyed cloths, russets, and habergies, 2 yards within the lists ‡."

It incidentally appears, that at this time the woollen manufacture was now established in Ireland, and had made considerable progress there, for Irish cloths were exported to England.

Woollen-drapers or dealers in cloth were also at that time settled in London; for in 1240 a duel was fought between Walter Blowberne and Hamon le Stare, the former having accused the latter of stealing cloths and other goods; among which were one coat of Irish cloth, and a particoloured coat of Abenden and Bunel of London.

At this period the woollen manufacture in other countries had reached a high state of prosperity. Ferdinand II., now recovering Seville from the Moors, found in it sixteen thousand looms for weaving woollen goods §. It appears, however, that in order to make their finest serges, the Spaniards bought wool, the growth of other countries, and chiefly from the Flemish market, to which the greatest part of the wool of England, now allowed to be exported, was carried for sale ‖.

The importation of foreign fine cloths was permitted by Henry III. The custom imposed was a source of revenue to him; and he did not consider, or care about the influence it might have on the manufactures and prosperity of the country over which he reigned. The immediate consequence was highly injurious to the wool-grower, whose fleeces, less used at home, and rapidly accumulating from the general goodness and cheapness of the imported fabrics, were hurried away to the Flanders market. This was another source of revenue to the monarch, and at which he had

* Madox's History of the Exchequer, p. 278. † Ibid.
‡ Anderson on Commerce. This was confirmed in 1224. 9 Hen. III. cap. 25.
§ Wansey on Wool, p. 38. ‖ Ibid., p. 29.

probably aimed. In process of time, however, that which was at first the result of distress, became the source of wealth, and the export trade in wool was, for several centuries, the most lucrative that the country possessed.

There has been much dispute, and it is a question difficult to be settled, when the exportation of British *cloth* commenced. Anderson, who is high authority, dates it from about this period, and asserts, that "from the time of Edw. I. to Charles I., the woollen manufacture and the exportation of woollen cloth and wool, were the principal objects of legislation; and that British cloth was sought for with avidity by all nations." On the contrary, Wansey, who maintains, as zealously as Anderson, the comparative fineness of the British wool in early times, and the superiority of the British cloths, asserts that it was not exported until a long time after this; and that the earliest mention of the exportation of British manufactures in any considerable quantity occurs in 1452, in the reign of Henry VII., and two hundred years after the period now referred to. He adds, that the export trade, then established, was not of much benefit to England, for it was managed by the merchants of the Steelyard, who were mostly foreigners.

Madox indirectly confirms the opinion of Wansey, for he says, that "Henry III. gave Simon de Campis, merchant of Douay, leave to import and sell his cloth in any part of England." Although the object of the king was the same as that of all the monarchs of those days, to fill his own coffers, it is scarcely probable that he would have given, or been allowed to give, this permission if the English manufacturers could have furnished sufficient cloth for home and foreign consumption*.

Neither of these valuable writers, however, is perfectly correct. British goods were occasionally exported from a very early period, but in small quantities, and bearing little proportion to the export trade in the raw material. A tax on them was collected by royal authority, but without the sanction of the legislature; and it was not until the time of Henry VII. that it was properly legalized, or yielded much to the support of the state.

Proofs of the ruinous effects of domestic strife, and the destructive influence of foreign wars, begin now to appear. The mark of gold annually paid by the weavers of Oxford for the privilege of forming themselves into a guild, was reduced to 42*s.*, (at 48 to the pound, and therefore equivalent to 17*s.* 6*d.*,) and on this ground, that "whereas they were above sixty in number when they undertook to pay the mark of gold, they were now so poor and decayed, that they were scarcely fifteen in number †." The tax on the weavers of Winchester was also reduced to 6*l.*

The woollen trade continuing to decay, and the British wool being returned by the Flemings in a manufactured state, better and cheaper than the impoverished and fallen artificers of England could produce it, the sale of English cloth seems to have rapidly declined, and threatened to go on to utter decay. The monarch listened to the grievances of his subjects, and consented to abandon one of the most profitable sources of his revenue; and the exportation of British wool was forbidden under very severe penalties. This exercise of regal self-denial, however, continued during a very short period. The ports were again thrown open—the wool was exported in any quantity that the adventurer chose, and the custom exacted varied according to the caprice of the monarch.

* For a more detailed account of this matter the reader is referred to a pleasing little book, "Wansey on Wool." The author detects many inaccuracies in the valuable work of Anderson.

† Madox, Hist. of Exchequer.

About this time mention is first made of the woolstaplers. The grower contented himself with the sale of his wool at his own door, or at the nearest town. Thence arose a description of middle-men or merchants, who bought it of him, and arranged it according to its quality, and instituted a kind of traffic between the grower and the home manufacturer or the foreign merchant. This guild was incorporated under the name of "staplers*." The word staple means the natural or usual products of the place †.

A misunderstanding having taken place between England and Flanders in 1275, all commerce between the two countries was prohibited; but Edward I., whose coffers were then exhausted by his Welsh expeditions, permitted certain Florentine merchants to export to Flanders 1068 sacs, or 281,952 lbs. of wool on the payment of 10*s.* (7*l.* 10*s.*) per sack duty—almost 7*d.* in the pound. The exportation of this great quantity, and by one company only of merchant-adventurers, shows the demand for British wool abroad, and the high estimation in which it was held. The kind of wool the historians of the time neither mention, nor perhaps understood; but from several incidental circumstances, it would appear to be the combing-wool, which then, as now, had no rival. The quantity exported in any given year is not to be collected from these imperfect records: but the export trade continued to increase, and that for two very sufficient reasons, viz., the penury of the monarch by whom it was encouraged, and the little and rapidly diminishing use for the wool at home.

From 10*s.* per sack, the custom was speedily raised to 20*s.*, and in the year 1286, Edward, by his sole power and authority, increased it at once to 40*s.* The agriculturists complained—petitioned. "It seemed not to be sufficient," they said, "that the home trade was ruined; but by this new exaction their wool was raised above the price that any manufacturer could afford to give, and was, in fact, driven out of the foreign market." The monarch was at first indisposed to listen to this just remonstrance, for the produce of the tax was too necessary to him; but, the petitioners preparing to assume a firmer attitude, Edward wisely yielded. He reduced the custom to 20*s.* as before, and promised that it should not again exceed that sum except by the consent of his people, expressed in parliament ‡. That promise was kept for a few years, but afterwards forgotten whenever the sinews of war were required.

In those times commerce was loaded with numerous oppressive and absurd restrictions. It was with great difficulty, and often not until after much sacrifice, that foreigners were permitted to settle and trade in other countries. In the year 1286 merchant-strangers first obtained licence to rent houses in England, and buy and sell their own commodities; for before this time they were compelled to hire lodgings, and the landlords were the brokers, through the medium of whom every bargain was transacted §.

* The woolstaplers have now no virtual existence as a chartered company; but the dealers in wool form one of the numerous bodies constituting the livery of London, and have a small sum of money in the funds, the interest of which defrays the expenses of their meetings and elections.—Anderson on Commerce, vol. i. p. 232.

† Lex Mercatoria by Gerard Malines.

‡ Rapin preserves the words in which this renunciation of the regal claim was expressed. They are worthy of record as one of the charters of British liberty. "And for so much as the more part of the commonalty of the realm find themselves sore aggrieved with the Maletent of wools, that is to wit xl shillings for every sack of wool, and have made petition to us to release the same, WE at their request have clearly released it; and have granted for us and our heirs, that we shall not take any such things without their common assent and good-will."—Rapin, p. 378.

§ The first result of this experiment, or rather this act of justice and humanity, is given in the words of Fabian. The persons referred to were wool-merchants. "In this yere also, whereas of olde tyme, longe before this season, the marchauntes straungers

In 1206, the company of merchant-adventurers, afterwards called the Hamburg Company, was established. They consisted of merchants from all the states that then owed allegiance to the king, and more from abroad than from his native kingdom. In process of time they became almost entirely foreigners. They had power to associate themselves into a body politic; to choose their own officers, to make their own laws for the direction of their business, to impose their own duties, and to act as an independent body. They soon monopolized to themselves the principal part of the commerce of the country, and although, to a certain extent, the interest of the public was theirs, it was too often found that the general prosperity and that of their individual corporation were altogether incompatible. Various abuses gradually crept into the management of this company. A spirit of monopoly and tyranny characterized their proceedings; and although they retained the protection of every successive monarch by being able and ready to supply his temporary necessities, they at length, after a continuance of 350 years, gave way to the expression of public feeling, and ceased to exist.

For many years nothing occurred worthy of note. The price of the sheep is incidentally mentioned, and remained nearly the same as many a century before. In 1299, the price of a fat lamb in London, from Christmas to Shrovetide, was 16*d.** ; three years afterwards, the price of a fat wether was 1*s.*, and that of a ewe, 8*d.* †; and in 1309, there is a notice of an extravagant price given on occasion of an installation feast: 200 sheep cost 30*l.*, or 3*s.* per head ‡.

The exportation of wool to the Netherlands, both from England and Spain, had now so much increased, that the cities of the Netherlands were in the most flourishing condition. In Louvain there were reckoned more than 4000 master-weavers and woollen-drapers, and above 150,000 mechanics. The city, although a large one, would not at present contain one half of these inhabitants §.

The year 1313 furnishes a very singular account of the different kinds of cloths at that time manufactured in England, and the difference which then existed between the rich and the poor. The expense of the household of Thomas Earl of Leicester is given. Among other things are 159 pieces of cloth for the earl, the bishop, the knights, esquires, clerks, officers, grooms, archers, and minstrels, 460*l.* 15*s.*, or on the average, nearly 3*l.* each—a very considerable sum at that period; 111 pieces for summer cloaks for the same persons, 345*l.* 13*s.* 8*d.*, being more than 3*l.* each; and for the poor men on Maundy Thursday, 168 yards of russet cloth, and 24 coats, and money besides, only 8*l.* 16*s.* 7*d.*||

comynge with theyr marchaundise were lodged within the cytezins of the cytie of London, and sold all their marchaundizes by the procuring of his hoost, for which his sayd hoost had a certayne of every lib.—it now was brought to passe, that they might hire to them houses for to dwell in, and for the stowage of theyr wares." These foreign merchants then either began to impose upon the native ones by reason of the increased opportunity they had for so doing; or from the jealousy of the natives, who were deprived of the opportunity of living upon the foreigners, accusations of that nature were maliciously brought against them: "Theyr weyghtes were brent and consumed, and fynallie the said marchaunts were delivered by fyne made to the kynge of a thousande poundes, when they had suffered for a season harde and vyle prysenment." Such was the justice of those days.—Fabian's Chronicles.

* Stillingfleet's Chronicon Rusticum, p. 66.

† Dugdale's Hist. of St. Paul.

‡ W. Thorn, inter Decem Scriptores. The reader will not much err if he multiplies these sums by 15, as expressive of their proportionate value at the present day.

§ Anderson on Commerce, i. 273.

|| Stowe's Survey of London.

In 1315 a dreadful epidemic broke out in Great Britain, and was confined almost entirely to that island. It arose from a long continuance of rain, which inundated the whole country, rotted the grain, and destroyed the fruits and herbage of every kind. It was followed by a violent dysentery equally fatal to the human being and the brute *. The consequence of this was a grievous famine, which lasted three years, and devastated the whole country. Food of every kind became extravagantly dear, and it was deemed advisable to institute some sumptuary laws: no one was permitted to demand more than 20*d.* (25*s.*) for a fat sheep; if it was shorn, the price was to be 14*d.* (17*s.* 6*d.*) This is a somewhat interesting morsel of history, for it gives the average value of the fleece at that time 6*d.*—7*s.* 6*d.* of the present money—being nearly half as much as the value of the carcase. It will be rendered sufficiently evident in the course of this work, that the modern sheep have increased far more in weight of carcase than of fleece, and that there was far less disproportion between the value of these formerly, than now.

The export trade was in 1320 better regulated, at least so far as regarded the collection of the customs. In order to prevent the fraudulent shipping of it, certain ports were named, at which alone it could be embarked, under pain of forfeiture and fine. These were Weymouth, Southampton, Boston, Yarmouth, Hull, Lynn, Ipswich, and Newcastle.

In 1327, Edward III., the reviver of the woollen manufacture in England, or, as some erroneously say, the founder of it, ascended the throne.

The Pensionary De Witt well describes the debased state of the woollen manufacture and the relative situations of England and the Netherlands at that time:—"Before the weaving trade was removed to England, the Netherlands could formerly deal well enough with that kingdom, the English being only shepherds and wool-merchants, and their king received few imposts but from wool exported, depending on the Netherlands, who were almost the only wool-weavers in Europe."

The summary of what Edward effected cannot be better given than in the language of the anonymous author of a book published in 1599, and entitled "The Golden Fleece."

"The wools of England have ever been of great honour and reception abroad, as hath been sufficiently witnessed by the constant amity which, for many hundred years, hath been inviolably kept between the kings of England and the Dukes of Burgundy, onely for the benefit of the wool; whose subjects, receiving the English wool at sixpence a pound, returned it (through the manufacture of those industrious people) in cloath at ten shillings a yard, to the great enriching of that state, both in revenue to their sovereign, and in employment to their subjects, which occasioned the merchants of England to transport their whole families in no small numbers, into Flanders, from whence they had a constant trade to most parts of the world. And this intercourse of trade between England and Burgundy endured till King Edward III. made his mighty conquests over France and Scotland, when, finding fortune more favourable in prospering his achievements then his alledgeate subjects were able to maintain, he at once projected how to enrich his people, and to people his new conquered dominions; and both these he designed to effect by means of his English commodity wooll; all which he accomplished, though not without great difficulties and oppositions, for he was not only to reduce (bring back) his own subjects home, who were, and had long been settled in those parts, with their whole families, many of which had not so certain habitations in England as in Flanders; but he was also to invite clothiers over to convert his

* Paulet, Recherches sur Epizootiques, vol. i. p. 85.

woolls into clothing (and these were the subjects of another prince), or else the stoppage of the stream would choke the mill, and then not onely clothing would every where be lost, but the materials resting upon his English subjects' hands would soon ruine the whole gentry and yeomanry for want of vending their woolls. Now, to show how King Edward smooth'd these rough and uneven passages, were too tedious to this short narrative, though otherwise in their contrivance, they may be found to be ingenious, pleasing, and of great use.

"But this it must be granted, that King Edward was wise as well as victorious, for upon a visitation made by himself to the Duke of Burgundy, during his residence there, he employed such able agents among the Flemish clothiers, as (barely upon his promises) he prevailed with great numbers of them to come into England soon after him, where he most royally performed those promises, in giving not only a free denization to them, but he likewise invested them with privileges and immunities beyond those of his native subjects, which peculiarities their posterities enjoy to this day. But for the more sure establishment, and before these preparations came into effect, King Edward, upon his return, called a parliament, and that in the beginning of his reign, where he so wrought with the Commons-house, (who had not the least knowledge that the king had moulded the design) as after long debate (which all motions in that house ought to undergo) it was presented to the Lords, and so to the King, who, among other *objections*, urged the loss which must necessarily befall his revenue, as well in respect of the outward subsidy of a noble upon each sack of wooll, which was to be transported, as of the inward custome which the cloath paid upon return, according to the rates then established. But these soon met with an expedient, for the cloath in time to come must needs yield a far greater custome upon that which was to pass into all parts of the world from England, than it could do upon that small return which came onely to the service of England, and therefore for the wooll, which from that time forward was to be wrought in England, and of which none in any sort, without the king's especial licence, was to be transported, the parliament gave unto the king a subsidy of a noble upon a sack.

"Seventy families of Walloons were in the first year brought to England by the invitation and promises of Edward. He kept his royal word to all of them. The greater part were at first settled in Kent, but they were by degrees removed to different parts, and scattered over the whole of England. They shifted their residence according to the facility with which they could obtain water or fuel, or the material on which they worked. The greater number finally settled in Yorkshire, Gloucester, and the western counties."

Anderson very properly remarks, p. 23, "that Edward III. was the first of our kings who clearly discovered the vast benefits accruing to a nation by foreign commerce and manufactures; and it may be added that England, much to her honour, was the first great monarchy in Christendom that entered into any considerable foreign trade and home manufacture; while the other great monarchies continued to contemn the pursuit of mercantile advantages, which they left entirely to the petty states and free cities of Italy, and those of the Netherlands and Hans towns *."

A double motive might have operated on the mind of Edward,—a desire to obtain the means of extending his conquests, for they were not then so complete as the author of the "Golden Fleece" describes them to be; and a desire, separate from his own personal interest, to benefit the people whom he governed. He succeeded; and although historians have been

* History of Commerce, Introd., p. 32.

strangely forgetful of this the most glorious achievement of his reign, he recalled, re-established, and would have established for ever, the staple manufactory of his country, and the most effective source of her power. If the wars of the Roses, which succeeded, once more reduced the woollen manufactory to the state in which he found it, the fault was not his. The Parliament which assembled in 1337, when this monarch was but twenty-five years old, enacted, that no wool of English growth should in future be transported beyond sea. This apparently deprived the monarch of a material source of revenue; but he consented, and that consent was politic, as well as patriotic. The Parliament also decreed that no foreign cloth manufactures should be received, from whatever port they came; and that no one should wear any cloth made beyond the sea; and also that a tax should be paid to the king, of 20*s.* on every sack of wool employed in home manufacture on every piece of cloth of British texture. The consequence was, that before the expiration of the first year, he enjoyed a revenue greater than he had before possessed, and built on a surer foundation. The prosperity of the home manufacture had its effect on the grower of the wool. The flocks of sheep rapidly increased, and the supply of wool became greater than the market at home could dispose of: it began to lie on the hands of the grower, and at the entreaty of the grower and the manufacturer, the prohibition against exportation was removed, and from this quarter also, the monarch derived a greater revenue than any of his predecessors had done.

His wars in France continued; but he found in the commerce in wool an inexhaustible resource. When his treasury ran low, he appealed to the patriotism of his people, either to increase for a while the duty on exportation, or to anticipate the payment of their taxes, or to grant him a loan for a certain period. When they had no money to offer, they produced their wool. He had increased the quantity and the value of it. It found a ready market every where,—his immediate wants were without delay supplied, and in due time the debt was discharged. Edward, young in years, but old in policy and wisdom, foresaw all this. Why have so few historians done even cold justice to him, or why should a strange and almost universal silence prevail with regard to another principle, to which the youthful monarch could not be quite insensible, that of patriotism?

The impulse to a reviving trade having been given, some of the old arbitrary restrictions were removed. The English monarch soon observed that the woollen trade assumed a buoyancy and vigour, which it would be impolitic to confine within the narrow bounds of his dominions; he saw that he had no cause to fear from the competition of others; and he reasoned that he could not expect from others facilities which he did not grant to them; and therefore he threw open the British trade to all countries, both the exportation of British wool, and the importation of foreign cloth, on the payment of a certain tax. When the English wool again began to find its way to Flanders, it readily sold for almost any price that the merchants chose to ask. Smith* says that it was worth 18*l.* or 20*l.* a sack; and Rapin adds†, that, in this very year, 1337, English wool sold in Flanders at the exorbitant rate of 40*l.* per sack. Ten thousand sacks (2,640,000 lbs.) were said to be bought in Brabant at that price, which is rather more than 3*s.* a pound, the difference in the value of money not being reckoned.

There must be some error in this, or there were circumstances with regard to which the historian is silent, that had an extraordinary influence

* Chron. Rusticum. † Acta Regia, p. 151.

on the price of wool at this particular period:—20*l.* per sack, or 1*s.* 6*d.* per lb., the value of money (although then beginning to decline) being taken into consideration, would constitute a price scarcely credible.

There is a document quoted by Smith, which records the prices of English wools in 1341, for home use and for exportation, and which is far more likely to be correct. It is a highly valuable one, not only as giving the price of wool, but the relative value of the wools grown in different districts at that period.

| | To the staple for home use | | | | | | | | | | For exportation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | per sack. | | | per stone. | | | | | | | per sack. | | | per stone. | |
| | £ | s. | d. | s. | d. | £ | s. | d. | s. | d. | £ | s. | d. | s. | d. |
| Salop . . | 6 | 6 | 4 | 5 | 0 | 7 | 6 | 4 | 5 | 9 | 9 | 6 | 4 | 7 | 3½ |
| Do. stuffs, including Leicester . . | 5 | 6 | 8 | 4 | 2 | 6 | 6 | 8 | 4 | 11 | 8 | 6 | 0 | 6 | 5½ |
| Nottingham . . | 4 | 13 | 4 | 3 | 7 | 5 | 13 | 4 | 4 | 4 | 7 | 13 | 4 | 5 | 10½ |
| York and Rutland | 4 | 10 | 0 | 3 | 5½ | 5 | 10 | 0 | 4 | 2½ | 7 | 10 | 0 | 5 | 9 |
| Derby . . . | 3 | 3 | 4 | 2 | 5 | 4 | 3 | 3 | 3 | 2 | 6 | 3 | 4 | 4 | 8½ |
| Cumberland and Westmoreland . | 2 | 13 | 4 | 2 | 1 | 3 | 14 | 4 | 2 | 10 | 5 | 13 | 4 | 2 | 4½* |

These were principally or entirely long wools, such as were required for the manufactures of Belgium, and also for the serge manufactories of Spain. On this account the Ryeland wools and the wools of the south-eastern districts are omitted. The Cotswold is probably included in the Salop.

If the best wool usually cost the merchant 9*l.* 6*s.* 4*d.* per sack before it was shipped, it may be imagined that, under some extraordinary circumstances, the price in Belgium might be 18*l.* or 20*l.*, but the tables of Smith and Anderson give a more correct statement of the average price at that period, and a high remunerating price it is. Considering the value of money to be now materially changed, and that the multiplier should be 12 only instead of 20, the price of the best wool at the first-hand would be more than 4*s.* per lb., and it is no longer surprising that the wool-grower was able to submit to impositions in the name of taxes, benevolences, and tolls, which would have absolutely ruined the farmer of the present day. If the account given by Rapin of the quantity of wool exported to Belgium at this period can be relied on—2,640,000lbs.—and that of fine wool which sold at a most extraordinary price, it is nearly three-fourths of the weight of wool of every kind which is exported at the present moment; and if to this is added much coarser wool, likewise sent thither, and the immense quantity used in the home-manufacture, it will be sufficiently evident, that the aggregate growth of wool could be scarcely inferior to that of later times.

In 1342, the king sent a great number of sacks of wool to Cologne, in order to redeem Queen Philippa's crown, which was pawned there for 2500*l.* The average price of that wool was 1*s.* 3½*d.* per lb.†

* Anderson, in his Origin of Commerce, gives a nearly similar account of the prices of some of the wools in 1343, when exported—Shropshire, 9*l.* 6*s.* 8*d.* per sack; Oxford and Staffordshire, 8*l.* 13*s.* 4*d.*, and Leicester, Hereford, and Gloucester, 8*l.* The lowest wool is that of Cornwall, which is valued at no more than 4*l.*

† The wool had hitherto been weighed by means of steelyards of nearly the same construction with those in country places at the present day; and hence the yard in which the merchants usually meet was called the Steelyard. A great deal of deception might be practised by varying the weight which was appended to the beam, and also by falsely graduating the beam; and it would seem that this was carried to so great an extent, that in 1352, the weighing by means of the steelyard was prohibited, and an equal balance introduced.—Chron. Rust. i. p. 38.

In 1354 the exports had risen to 31,651 sacks of wool, or to the almost incredible quantity of 8,356,864 lbs., the duty on which the wary Edward, taking advantage of the turn of the times, added to his treasury, amounting to 277,606*l.* 2*s.* 9*d.* of money, or three and a half millions of pounds, according to present computation*.

Now likewise occurs the mention of the first exported manufactured goods, 4774½ cloths (probably broad cloths), of the value of 40*s.* each, and amounting to 9549*l.*; and also 8061 pieces of worsted (worsted goods of various kinds), and valued at 16*s.* 8*d.* the piece, and amounting to 6717*l.* 18*s* 4*d.* The duty on these was 215*l.* 13*s.* 7*d.*, and the whole amount of the value of the goods and the duty was 16,481*l.* 11*s.* 11*d.*

On the other hand, there were imported 1832 cloths (broad cloths) of the value of 6*l.* each, and, with the duty, amounting to 11,083*l.* 12*s.*; and leaving a balance in favour of the imports of 5397*l.* 19*s.* 11*d.* But the whole commerce of the year left a balance in favour of the exports of 255,214*l.* 13*s.* 8*d.*, or, computing the difference in the value of money and expense of living, 3,825,220*l.* 5*s.*; a most extraordinary balance, and showing the frugality of the times and the resources of the country †.

The art of spinning worsted yarn had now made much progress in England. This peculiar species of manufacture seems to have been first established in Norwich, which was at this period become a large and populous town. The quantity spun there does not appear, for some time, to have been sufficient for the home supply, and therefore, in the year 1348, the exportation of these yarns was prohibited. In a few years afterwards, however, the worsted yarn was exported in considerable quantities, and then the manufacture of it rapidly extended through the whole of the county, and through Suffolk and Cambridgeshire southward, to the midland counties westward, and to Yorkshire towards the north.

As the woollen trade increased, various impositions began to be practised. The reader may see a long and somewhat humorous, yet disgusting list of them in "The Golden Fleece," already referred to. In order to prevent these frauds, an *alnager*, or sworn officer for the inspection of woollens was appointed. Mention is first made of him in the year 1352. It was his duty to measure the pieces of cloth exposed to sale, and inspect their quality; but, if the author of "The Golden Fleece" is to be believed, he too frequently paid more regard to the accumulation of his own fees than to the collection of the duties of the crown, or the preservation of the subject from imposition. Regulations were also this year enforced with regard to the sorting of wool, an operation which left too much room for fraud.

In this year also Edward made another successful experiment on the benevolence of his people. Berwick was sacked by the Scots. In order to enable him to recover it, an impost of 50*s.* per sack was levied on all the wool exported for six years, "so that," says Wheeler, "the said king might dispend everie day 100 markes, which in sixe yeares time amounted to 1,500,000 pounds, reckoning 100,000 sacks of wooll a yere transported ‡."

This author, being secretary to the company of Merchant-Adventurers, had access to every source of correct intelligence, and would scarcely dare to deceive; yet this seems an almost incredible quantity of wool exported. 100,000 sacks are equivalent to 36,400,000 lbs. Although the British commerce at the present time extends to every quarter of the world, and German wools either constitute the sole material, or form the greatest proportion in almost every fine cloth, the whole importation does not amount

* Anderson on Commerce, i. 335. † Misselden's Circle of Commerce, p. 119.
‡ Wheeler's Treatise on Commerce, 1601, p. 64.

to 40 millions of pounds, and the exportation is not quite one-eighth of that quantity*.

In 1386 Richard established a company, or guild, of linen-weavers in London. They had emigrated from the Netherlands, where the linen-manufacture was in a flourishing state. These men were much annoyed by the woollen weavers' company. It was difficult to wean a nation of shepherds from their attachment to wool, and the project failed.†

In 1388, by Act of Parliament, the wages of the bailiff of a farm, exclusive of his board and lodging, and clothing, once a year, was 1*l.* 13*s.* 4*d.* per annum. The wages of a carter, or shepherd, 10*s.*, and that of the cow-herd, and ox-herd, 6*s.* 8*d.*

In 1382, the 5th of Richard II., a circumstance occurred, so connected with the liberties of England, and doing so much honour to the Parliament then sitting, that it must not be passed over in silence. "The Lords and Commons fearing lest, by the continual grants of the subsidies of wool, the same would grow into custom, and so be challenged by the king as of right; for avoiding this, granted to the king the like subsidy of wools as was last granted, from the feast of the Circumcision until Candlemas then following, so as the space between Christmas and the Circumcision should be an interruption to the king's claim if it were attempted ‡."

In 1390, the 13th of the imbecile Richard II., the exportation of wool was prohibited to the natural subjects of the kingdom, and the privilege granted only to certain favourites and foreigners. Wool then became so cheap, that the best of it was sold at 3*s.* per stone, and the grower could obtain no more than 20*d.* or 2*s.* per stone. This gave rise to great murmurings and threatenings of insurrection, and the king was compelled to throw the exportation trade open as before. The consequence was, that no fewer than 130,000 sacks were exported in the following year, and each charged with a duty of 40*s.* § 130,000 sacks contain 47,320,000 lbs. of wool.

* In 1382 leave was given to export to Rome, as a present to the Pope, six pieces of green tapestry, powdered with roses; two great pieces of red serge, for adorning a hall, worked with the arms of the Pope, the King and the Church; various mantles of cloth; various beds with testers; lined garments; hoods, common, and for days of ceremony, &c. &c., showing that the woollen manufacture had now made considerable progress in England.—Rymer's Fœdera, vol. vii. p. 356.

† Anderson on Commerce, i. 379.

‡ Chronic. Rust. i. 52.

§ In the seventeenth year of this monarch, an act was annulled, which should never have had existence. The regulations determining the length and breadth of every description of cloth, and which was not to be deviated from under very severe penalties, was repealed, and every person was permitted to make his cloth of what length and breadth he chose.—Chron. Pret. i. 55.

Under Henry VII. these absurd restrictions were again enforced.—Idem. 62.

In Rymer's Fœdera, there is a curious record of the whole of the revenue of Henry V. in the last year of his reign, and showing how great a portion of it was derived from the sheep:—

| | £ | s. | d. |
|---|---|---|---|
| Duty on wool exported . | 3976 | 1 | 2 |
| ,, on 80 manufactories at home | 26,035 | 18 | 3½ |
| Small customs, miscellaneous . | 2438 | 9 | 1¼ |
| 12*d.* per pound on all goods, probably both exported and imported . | 8237 | 10 | 9½ |
| Quit-rents, fines, &c. . . | 15,754 | 11 | 1¼ |
| | 55,754 | 10 | 10½ or about 836,320*l.* |

of the present money.

More than 30,000*l.* of this is derived from wool exported and manufactured, and probably a considerable proportion of the 8237*l.* was derived from woollen goods imported or exported.

From this period the price of British wools appears to have progressively declined; and it may not be difficult to assign a cause for it. The Spanish wools were becoming more in repute, they were employed extensively in the manufacture of broad cloths; and from the altered condition of the inhabitants of the Low Countries, the fashion of the times changed too, and the nature of the fabrics was changed, and worsted goods, and not of the same good quality, were more in request. This would speedily influence the character of the fleece. The intelligent agriculturist knows well how to grow the wool which the fashion of the day requires; and now, probably, began a change in the character of the sheep in France, in the Netherlands, and in England. The Romney Marsh, and the Lincoln, and the Leicester, if they did not then spring as it were into being, were at least more diligently cultivated, and the older fine-woolled sheep were to a lamentable degree abandoned *.

Notwithstanding this, however, the long wools continued to be decidedly superior to those of foreign growth, and accordingly attempts were made to export not only the British fleece, but the sheep too. The practice was rapidly increasing, and was fraught with mischief to the British sheep-owner. A law of Henry VI., in 1425, forbids it. The preamble states, that "whereas divers persons have from time to time carried out of the realm great numbers of sheep with fleeces into Flanders, and other countries beyond the sea, and there shorn them, and sold both the sheep and the wools, and thus the number of such sheep in the said country of Flanders is likely to be much increased, and the custom of wool lessened, and the price of wool abated;" therefore, under forfeiture of the sheep, the exportation of them was thenceforward prohibited, unless special licence was obtained for the same †.

This confiscation was afterwards considered an insufficient punishment of such a crime, and in the eighth of Queen Elizabeth it was enacted, that the first offence should be followed by forfeiture of all the goods, and imprisonment for a year, and the loss of the left hand. The second offence was made felony, without benefit of clergy. This law is, to the disgrace of the statute-book, still unrepealed. The secure foundation of the staple commerce of our country and the true principles of trade are now, however, better understood, and the enactment remains as a dead letter, yet a blot on our legislature ‡.

The Scots now carried on considerable traffic with the Flemings; and very great quantities of the northern wools were exported, which, although not so fine as those of England, served for various manufactures. Their own manufactured coarse woollen goods were also sent, and found a ready sale; and the Scots being even a more frugal people than the English then were, the balance of trade was very much in favour of their country §.

In 1437, Don Duarté, king of Portugal, and brother-in-law to the king of Castile, from whom he might have easily obtained the choicest of the Spanish wool, made application to Henry VI. for liberty to export 60 sacks of Cotswold wool, in order that he might manufacture certain cloths of gold at Florence for his own use ||. Anderson very wrongly remarks, that "the superiority of the English wool above the Spanish of that day is here clearly ascertained." He forgets that, whatever might have been said of the English short wools in earlier times, there could be no competition between the long Cotswold wool and the Spanish wool. They

* Luccock on Wool, p. 56. Chron. Pret. An. 1425. Anderson on Commerce.
† Anderson on Commerce, vol. i. p. 441. ‡ Idem, p. 442. § Idem.
|| Chronic. Pret. p. 86.

were essentially different; the first was a combing, the other a carding wool, and they were employed in the manufacture of fabrics altogether unlike. Don Duarté wanted one of those light and beautiful fabrics which used to be prepared with the long wool, and which that alone could yield; and with no disparagement of the Merino wool, which was suited to fabrics of a closer nature, he had recourse to the Cotswold fleece.

The government of the Low Countries began now to be jealous of the rapid increase of the British woollen manufactures, which necessarily caused a corresponding diminution of theirs, and they prohibited the exposure and sale of the British fabrics in any of their markets. This was a most injudicious act, for they were dependent on the supply of British wool for the existence of their remaining manufactories, and which were numerous and valuable. An order of Henry's Privy Council, forbidding the reception of the Flemish cloths, and the exportation of British wool, soon brought the Netherlands to their senses: their prohibition was repealed, and all things went on as before *.

A paragraph in Stillingfleet gives the price of sheep about the middle of the reign of Henry VII. In 1449, 15 sheep were sold for 36*s.* 10*d.*, or at the rate of 2*s.* 5½*d.* each, or, according to the value of money at that time, 29*s.* 6*d.* †

In 1453 a new era in the British manufacture may be said to have commenced. The Chinese appear to have been first acquainted with the manufactory of silk. In the time of the Romans it had found its way to the islands of Greece, but was long confined to the Greek empire; thence it diffused itself to Sicily; by degrees it established itself in Italy, and was carried into Spain; at a still later period it was adopted by the French. Fabrics of silk had been occasionally used in England for more than 200 years prior to the time now under consideration. In 1251, at the marriage of Margaret, the daughter of Henry III., a thousand English knights appeared in clothes of silk. When, in 1415, Henry V. embarked on his expedition to France, one of his ships carried a sail of purple silk, on which were emblazoned the arms of England and France; but it was now for the first time that it could be concluded that the manufacture of silk was known in England, and certainly never until now had it been placed under the protection of the law. By an express enactment, the importation of wrought silk was forbidden in England.

In 1641 the commerce in wool had again begun to experience the paralysing influence of civil war. The manufactories of it were almost closed, and the price of wool, not perhaps of the best quality, had fallen to 18*d.* the stone, or somewhat less than 16*d.* per lb., according to the present value of money. The sheep-growers began with much reason to complain; the people of Bristol and of Norfolk were foremost; and Edward IV., who had just fought his way to the throne, prohibited the exportation of wool except to the town of Calais.

In 1464 the celebrated present of Cotswold rams was sent by Edward IV. to Henry of Castile; and in 1468 another flock was shipped for John of Aragon ‡. It has already been stated that they were designed to improve the long-woolled breed of Spain. They never mingled with the migratory flock, from which the modern Merinos have descended.

It appears from the records of the same year, that the master clothiers had discovered and adopted the unfair practice of paying a part, if not the whole, of their workmen's wages in goods of various kinds. They now compelled their people to take pins and girdles, and various unprofitable wares,

* Anderson on Commerce, vol. i. p. 469. † Chronic. Pret. p. 86.
‡ Anderson on Commerce, vol. i. p. 493.

instead of money, and at such rates as they chose to impose. Great discontent arose among the mechanics; complaints were made to the government, and it was enacted, that "the clothiers shall pay ready money to their work-people, and shall deliver wools at the due weight thereof, under forfeiture," &c.*

Edward, in his zeal to restore the trade in wool to its former prosperity, had meddled somewhat incautiously and arbitrarily with some of the manipulations in the manufacture of certain cloths. The Devonshire weavers, who it seems were at this time engaged in the fabrication of serges and goods of that description, had thought it advantageous to mix with the coarser wool used in their cloths some of "the flocks,"—the small portions of wool which were torn off the cloth as it passed over the cylinder in the act of dressing, and which then, probably, as now, were thought by some to be of little more worth than to be used in the filling of mattresses. This had been represented to the government as an act of imposition by some busybody who knew nothing about the matter, nor to what a degree the coarse and unyielding fibre of the Devon wool might be softened by admixture with these flocks, bruised and broken down by the action of the cylinder; and Edward had condescended to legislate about an affair like this, and had strictly forbidden it. Anderson says, "that the hundreds of Liston, Tavistock, and Roxburgh, in the county of Devon, stated they had been accustomed from time immemorial to use flocks, and that without this indulgence they must be undone, because their wool is so gross and stubborn, that cloth cannot be made thereof without mixing with flocks." In consequence of this memorial, the act was, of course, immediately repealed; but how degraded must the government have appeared that could ignorantly concern itself with trifles like these †!

In the next year but one, 1470, there is an opportunity of comparing the price of Spanish wool at that time with the depreciated value of the English. A Spanish vessel, bound for the Netherlands, was taken by an English privateer. The owners laying a claim for damages, the wool was stated as being worth 9*l.* 12*s.* per sack, or 6*d.* (6*s.*) per lb. But now English wool of the first quality would scarcely yield 2*d.* (2*s.*) per lb. at home; Sir John Paxton's was "right well sold" at 1½*d.* (1*s.* 6*d.*) and in the foreign market it was unsaleable or almost unknown. England had since been devastated from shore to shore by civil contentions. Needs there any other illustration of the duty of the government, and the true interests of the state?

Towards the close of the reign of Edward IV., a most shameful instance of favouritism occurs. He granted leave for his sister Margaret, Duchess dowager of Burgundy, yearly, during her life, to export from England, without paying custom, toll or duty, one thousand oxen and two thousand rams to Flanders, Holland, and Zealand. Her object doubtless was to improve the breeds of cattle and sheep; and the monarch forgot, or cared not, how deeply he wounded the commercial interests of his kingdom, dependent on the demand for British wool in the Flemish marts. The resemblance between the cattle on the two shores is thus well explained; and the traveller will cease to wonder that on the northern coast of France, and through nearly the whole of Flanders, he thinks that he finds again the identical sheep of the Kentish pastures‡.

* Anderson on Commerce, vol. i. p. 484.

† Ib. vol. i. p. 490.

‡ A very interesting letter from Margery Paston, wife of Sir John Paston, one of the members of the first Parliament of Edward, is preserved. She is staying at the manor-house, while the husband is attending to his duty in London. She thus writes:—"The people of this country live in hopes he shall help to set a war, that they may live in better

In 1489 King Henry VII., all whose acts were characterized by a narrow policy, in order to obtain a market for the inferior kinds of British wool that were accumulating on the hands of the farmers, enacted certain sumptuary laws. He imposed a penalty of 40*s.* for every yard of fine scarlet or other grained cloth that was sold at above 16*s.* per yard; and of any other coloured cloth above 11*s.* He even condescended to legislate respecting hats and caps: no hat was to be manufactured, the price of which exceeded 20*d.*, nor any cap—such as are seen on the heads of persons of rank in the old pictures of these and somewhat later times—above the price of 32*d.* This shared the fate of all absurd enactments of the kind: it was evaded in every possible way, and at no great distance of time annulled.

The interests of England and Flanders were most intimately connected, and it had been so contrived by the tacit consent of both parties, that whatever might be the quarrels between Britain and the continental states, the Low Countries should rarely be directly involved; but in 1793 a rupture took place between them, and all commercial intercourse ceased. This was severely felt by both countries: England could find no mart for her surplus wool, and the Flemings could not procure the material to feed their manufactures; and such an unnatural state of things continued during three years. The Lord Chancellor Bacon describes this with his usual quaint humour: "By this time the interruption of trade between the English and Flemish began to pinch the merchants of both nations very sore. The king, who loved wealth, though very sensible of this, held out so far as first to be sought unto;" and the Flemings, with most good sense, "speaking first," the quarrel ceased *.

The long reign of Henry VIII. succeeded, when the degradation of the British fleece was carried to a greater extent. It is true that no civil wars then raged, but the attention of the people began to be distracted by religious dissensions. The ultimate effect of these scenes was glorious to the cause of true religion and rational liberty; but during the process, the commercial interests of the kingdom were either abandoned, or sacrificed by a succession of crude, impolitic, and destructive enactments. The price of wool fell still lower than in the time of the seventh Henry, and attendant on that was the loss of motive to induce the farmer to take care of it; and, with that, the palpable deterioration of its quality—a deterioration from which perhaps it has never perfectly recovered. From the reign of this monarch the British short wool has not always headed the market at home, and abroad many a rival has sprung up successfully to combat with it; while

peace in this country, and that wools" (still even in their depressed state the staple produce of the agriculturist, aud that which was first in his thoughts) "shall be purveyed for, that they should not go out of this land as they have been suffered to do. Then shall the poor people live better than they have done by their occupation therein. Thomas Crome has sold all your wool here for 20*d.* per stone, to be paid at Michaelmas, and it is sold right well, because the wool was for the most part right feeble."—Fenn's Original Letters, vol. iv. lett. 12.

* The natural connexion between England and Flanders is thus pleasantly described by an old writer. It is to be remembered, however, that it is an Englishman who is telling his story:—

They (the Flemings) may not liven to maintain their degrees
Without our English commodities,
Wolle and tinne: for the wolle of England
Sustaineth the commons Flemings I understand.
Then if England would her wolle restraine
From Flanders, this followethe in certaine,
Flanders of nede must with us have peace,
Or els she is destroyed without lees [release].

Hakluyt's *Navigations*, vol. i. p. 188.

it would seem as if some of the old breeds of fine-woolled sheep had vanished altogether.

During the reign of this monarch, there occurred a few instances of the accumulation of wealth by certain manufacturers, which reminded the observer of the times when the woollen manufactory had not been ignorantly or systematically sacrificed. Foremost among them was John Winchcombe, better known by the cognomen of Jack of Newbury: he kept 100 looms at constant work, and had sent to Flodden Field 60 soldiers, fully equipped at his own expense.

In 1530, the twenty-fifth year of this reign, the spinning-wheel was invented by Jurgen of Brunswick. It is a simple machine, and is most intimately connected with the rapid progress of this branch of the woollen manufactory. The previous substitutes for it were complicated and ineffectual.

In 1531 the price of an ox was 1*l.* 6*s.* 8*d.*, a sheep 2*s.* 10*d.*, a hog 3*s.* 8*d.*, and a capon 6*d.* In 1533 a new regulation was enforced with regard to the sale of butcher's meat. It had been usual for the butchers to divide the carcase as they pleased, and to demand a certain sum for a certain piece or joint. This was supposed to afford room for much imposition; and it was enacted—(when the spirit of legislative interference is once excited, to what will it not extend?)—that the meat should be all sold by the pound: beef at 1½*d.* and mutton at three farthings the pound; the average price of a fat ox being then 26*s.* 8*d.*, and of a fat wether 3*s.* 4*d.* The folly of this was soon evident; and the absurd regulation was speedily repealed.

This account of the price of oxen and sheep throws some light on the comparative size and weight of these animals at the period referred to. It is well known that the black cattle—and there were few others at that time—were considerably smaller than they are now usually found to be; but the carcase of the fat wether, if it did not weigh more than one-eighth as much as that of the ox, must have been strangely diminutive. The truth is, that the sheep at that time was not bred for the carcase as well as the fleece, but almost or quite exclusively for the latter.

The same year was disgraced by the establishment of a monopoly of the manufacture of certain articles in certain towns, to the exclusion of the whole country besides. The city of York led the way. Its memorial stated, that "the city of York afore this time had been upholden principally by the making and weaving of coverlets, and the poor thereof were daily set on work in spinning, carding, dyeing, and weaving, and that the manufacture having spread into other parts, was thereby disgraced and discredited!!" The monarch listened to this worthy plea, and in accordance with the spirit of the times, and his own spirit too, he decreed that none should make coverlets in Yorkshire but inhabitants of the city of York. Worcester preferred the same complaint, and it was enacted that its peculiar manufacture should be restricted to that city and four other towns, Evesham, Droitwich, Kidderminster, and Droitwich. Worsted was declared to be the private commodity of the city of Norwich. Is it surprising that under Henry VIII. the woollen trade, thus "cabined, cribbed, confined," should languish, and go into comparative decay *?

In the next year there was a still more ridiculous interference with the sheep-breeder. The number of sheep that, with few exceptions, agriculturists were permitted to keep was not to exceed two thousand. The question of large or small farms comes not here under consideration, but the pretext was, the great rise in the price of various commodities; and the

* M'Culloch, art. Wool.

power which the large sheep-owner had to influence, and by a combination with others, determine the price of wool, and push it beyond all reasonable bounds. It was alleged that by means of a species of monopoly the price of sheep had risen to 5*s.* or 6*s.* each, and clothing wool from 3*s.* 4*d.* to 4*s.* per stone. If it were so, it was the best thing that could happen to a nation of shepherds and sheep-owners, and it was a state of affairs which the enlightened legislator would endeavour to perpetuate rather than change;—it was a state of affairs that should have been hailed with delight, as promising a return of the olden time, when the growth and exportation of wool was the foundation of England's glory. Whether such prohibition still continues to disgrace the Statute-Book the writer of this is ignorant; but on comparing the facilities which large farmers possess over small ones, with respect to the fattening of the sheep and the growth of wool, such restrictions must be highly injurious and absurd. This regulation was seldom enforced at the time when it was enacted, and it is now, and most advantageously for the general interest, universally neglected *.

The short reign of Edward VI. was distinguished by an attempt at that which at a more recent period formed so beneficial a revolution in sheep-husbandry,—the inclosure of the waste ground. The woollen manufacture only wanted to be let alone in order to flourish. The last ten or twelve years of Henry VIII. had been exclusively devoted to the accomplishment of his favourite scheme of separation from the church, and also to the exercise of much domestic tyranny, and the experience of much domestic suffering, and the woollen manufacture had been let alone. The consequence was, that the home trade was beginning once more to flourish, and the peace lately concluded with France opened a foreign market. The price of wool increased, and the farmer again took to the breeding of sheep. Unwilling to bring back to sheep-pasture the land which in the depressed state of the trade they had submitted to the plough, they wanted more ground than they possessed. They began to inclose the waste spots that were their own immediate property, and they were aiming at something like a general inclosure. This produced great discontent among the cottagers. While there were no overt acts of violence, the landed proprietors heeded not the complaints of the peasants, and a bill was introduced authorizing these inclosures to a very considerable extent; it passed the Lords, but was thrown out by the Commons. The Lords, however, and the generality of the landed proprietors, asserted their right to do as they would with their own, and the work of inclosure progressed. This gave universal discontent; and the Romish priests, anxious to avenge their own supposed wrongs, —anxious to recover their own supposed rights—exerted themselves to foment these complaints, and there were numerous risings of the people.

* In 1527 there was a repetition of the quarrel, and childish sulkiness between the English and the Flemings; Henry had imprudently leagued himself with the French against Charles V. of Spain, and that monarch forbade his Flemish subjects to deal with the British. The manufacturers and their workmen again suffered severely, and at length became tumultuous and violent. They were for a while appeased, and an interview took place between the merchants and Wolsey. "Why will you not buy these goods?" said he, forgetting that there were none to purchase them again, and showing, with all his other policy, his utter ignorance of trade; "if you continue thus to distress the manufacturer, the king himself will open a new cloth market at Whitehall, and buy up all these things and sell them again." "His Majesty," replied one of the merchants, "had better buy them at the old market at Blackwall, it will be more convenient for the foreigners." The Cardinal had nothing to reply to this, but dismissed the merchants with raising expectations that could not be realized, and which he never meant to attempt to realize—"that some way should be found to get rid of all the cloth and wool." The people were pacified for a while, but the evil remaining unredressed, they were again becoming discontented, when an unexpected truce restored everything to its proper channel.—Anderson on Commerce, ii. 50.

Norfolk led the way, and a general insurrection was threatened. The landed proprietors gave way: they restored not the enclosures which they had made, for they were wise enough to see the benefit they must ultimately derive from them; but they lowered their rents, and the peasantry were satisfied.

The short reign of Mary might likewise be passed over in silence, but for an incidental proof of the now rapid improvement of the woollen trade, and which will be found briefly stated in a note *.

In 1558 Elizabeth ascended the throne, and the religious disputes which had so long agitated and impoverished the country having been finally settled, the attention both of the government and the people was directed to the revival of commerce; and among the other branches of it, and the most important of the whole, the woollen manufacture. The times were propitious. The wise and firm administration of Elizabeth, and the quiet establishment of a religion embraced by the majority of the people, were pledges of lasting tranquillity; they were assurances that both the agriculturist and the manufacturer might once more securely embark their capital in the pursuit of England's staple trade. The situation of foreign countries was propitious. In the Netherlands and in France, religious dissensions had commenced; they distracted the attention of the people from the affairs of commerce; and in the minds of many they betokened the approach of a period when neither the property nor the lives of the disputants might be safe, and these persons cautiously retired from the evil to come. They found a refuge and a welcome in England. They brought with them their improvements in different manufactures, and began to employ them for their own emolument, while the native artisans were instructed and benefited. In the 6th and 7th years of Elizabeth, and before the storm had burst abroad, the woollen manufacture had so much increased, that the export of goods to Antwerp alone amounted to 750,000*l.*, and the whole value of the exports in 1564 was 1,200,000*l.*, or 1,300,000*l.*, and all fabricated of English wool †. This is a great sum for that period; but so decided a diminution of the trade of the Low Countries may be accounted for by the circumstances of the times. There were distant but evident threatenings of a religious civil war—an anomaly always most disgraceful and fatal. Venice was impoverished, and its trade destroyed by a nine years' war; South America was just discovered, and the consequence of this was, that gold and silver had become more plentiful in Europe, and trade had in every way increased. A commercial treaty had been concluded with Sweden, and the Russian Company had been instituted. All these things must have tended to give a new vigour to the woollen trade, and may be readily believed to increase it even to this extent ‡.

* On a creation of Serjeants at Law in 1555, Mr. Allen, a draper of Watling-street, was appointed to furnish the robes of ceremony. The following is a copy of his bill to each:—

| | £. | s. | d. |
|---|---|---|---|
| A robe of scarlet cloth, 5½ yards, at 33*s.* 4*d.* . . | 9 | 3 | 4 |
| Ditto violet ingrain, ditto at 18*s.* . . . | 4 | 8 | 0 |
| Ditto brown blue, ditto at 14*s.* . . . | 3 | 17 | 0 |
| Do. mustard & mursey, do. at 10*s.* . . . | 2 | 15 | 0 |
| | £20 | 3 | 4 |

Reckoning the different value of money, this is a very great sum, and furnishes another proof of the buoyancy of this manufacture, and the degree to which it seems to be naturalized to the British soil.—Dugdale, Origines Juridicales.

† Vide Camden.

‡ Guicciardini, speaking of the flourishing state of the Flemish cities, and particularly of Antwerp at this time, says, that "500 ships were often seen collected in her

Elizabeth continued to pursue that cautious and wise policy to which she was indebted for the success that attended all the proceedings of her government. The trade in goods of home manufacture so rapidly extending, she was urged to prohibit the exportation of British wool, and thus make the whole secure; but she at once refused. She knew that there could be no better means of diminishing the export of wool, if that were an evil, than the profitable employment of it at home. She gave every encouragement to the manufacturer; she permitted the grower to dispose of his produce as he pleased; and thus established the commerce of her kingdom on its only just and permanent basis.

The storm at length burst over the devoted countries on the other side of the Channel. The ferocious Alva overran the Netherlands, and his course was marked by the desert which he left behind him. In six years 18,000 men perished by the hands of the hangman alone; in France, nearly 100,000 persons were massacred in the course of a few days, and the destructive war of the Huguenots succeeded.

The number of the refugees now increased in a tenfold degree; the city of London contained no less than 5000 of them. The decayed towns of Canterbury, Norwich*, Sandwich, Colchester, Maidstone, and Southampton, were filled with manufacturers of woollen and silk†. Although there were some fanatics among them, the great majority were peaceful and grateful; and by the superior machinery and more skilful manipulations which they introduced, and the cheaper and better fabric which England was afterwards enabled to send into the market, they more than repaid the debt, and essentially contributed to the lasting prosperity of the country in which they found refuge.

"Thus," says the Pensionary De Witt, "when the compulsive laws of the Netherland Halls had first driven the cloth-weaving from the cities into our villages, and thence into England, and that by the cruelty of the Duke D'Alva, the say-weaving went also after it, the English by degrees began to vend their manufactures throughout Europe, and then they became potent at sea; and *he who is powerful at sea is a lord at land, and more especially a king of England*, seeing that by reason of the westerly winds, which blow for most part of the year on this side of the tropic, he is able, both whole fleets and private ships of war, to sail out of his numerous bays and harbours at pleasure, and destroy the navigation of his foes." '*Cui adhereo præest*,' was the motto of Henry VIII.—"He whom I assist shall be master.' This immutable lesson, as it regards the prosperity of England, is not foreign to the present work. The prosperity and glory of England were first based, and they must ever rest, on her pre-eminence at sea, and that arose from her commerce; and for many a century the staple, almost the only articles of British commerce, were the fleece of her sheep, and the fabrics manufactured from it.

port; that the English sent to them upwards of 1200 sacks of wool, and a vast quantity of drapery of all kinds, which, at the most moderate rate, amounted in value to a million pounds sterling, and that they carried away from Antwerp goods—he does not say of what kind—to the amount of 14,000,000*l.*, to the great benefit of both countries, neither of which could possibly, without the greatest danger, dispense with their vast mutual commerce, of which," he continues, "the merchants on both sides are so sensible, that they have fallen into a way of insuring their merchandizes from loss by a joint contribution."—Chron. Rustic. vol. i. p. 103.

* Norwich in an especial manner profited by this. It had been rendered almost desolate by Kent's rebellion in 1549, but it now learned from the refugees to make those fine and light stuffs which have ever since gone by its name, and have restored it to more than its former prosperity.—Anderson on Commerce, ii. p. 126.

Gibson, in his continuation of Camden, says that, about 1722, stuffs to the amount of 700,000*l.* were sometimes manufactured in Norwich in one year.

‡ Metereni's Historia Belgica, lib. iii.

The refugees were located at first in the neighbourhood of the metropolis, and on the coast from Norfolk to Devonshire, but they spread by degrees over the principal part of the kingdom. The manufactures which were principally benefited by them were those of light cloth, in which the English had hitherto been lamentably deficient; and also in every description of worsted fabric. When the stocking-frame was afterwards introduced, they were the chief and the best workmen. The linen and silk trades also derived much advantage from them. The manufacture of bombazeens seems to have been at this time introduced, and carried on principally at Norwich. The trade of that town had, in the preceding reign, from the system of monopoly which was adopted, risen to almost an incredible sum, and it was now still further and most rapidly increased.

Two years before the accession of Elizabeth, three ships had sailed up the Baltic for the purpose of establishing a trade with Russia; they were hospitably received by the then Czar, John Basilowitz, who had lately conquered the Tartars of Casan, to whom the Czars of Russia had hitherto been tributary; and more lately he had added to his dominions Astracan and Nagaian Tartary. The advantage of supplying his half-civilized subjects with the manufactures of Western Europe were immediately evident to the Czar, and he listened with complacency to their promise of a second visit, and gave the adventurers a letter of licence to traffic in any part of his extensive dominions.

The prospect which this afforded of opening a new and profitable market for the woollen manufactures was not lost on the government of England, and a company was established under the title of "The Russian Company." For many a year it much benefited the woollen trade: the British woollen cloths and kerseys were bartered for raw silk, spices, and drugs, which were afterwards sold to good account.

This was the first exclusive corporation that was established; but it did the state service, and never degenerated into an oppressive monopoly. The name is still continued: a fine is exacted for admission into the Company, but each individual conducts his business as a private individual, and precisely as he would do if the Company was abandoned *.

If the reader now pauses for a moment and reviews the different facts that have been stated, the conclusion will seem inevitable, that until the period now under consideration—the reign of Queen Elizabeth—English wool was decidedly superior in quality to any produced on the Continent, except the Spanish; that the British manufactured cloth, and made of British wool, was not excelled in fineness or value by any other, excepting —and not always, or decidedly—the Spanish; and that the English wool was coveted abroad for the purpose of giving additional value to the finest fabrics. As to the nature of the manufactured goods exported there may be some doubt, for the majority of the English historians neither knew nor cared about the matter; but the weight of probability is, that they were chiefly made from the fleece of the short-woolled sheep, and the wool exported was from the long-woolled sheep. The British had for many centuries been able to compete with the manufacturers on the Continent in the goodness of their broadcloths, but had not yet learned the way to turn their unrivalled long wool to the best account.

A new era in the history of British wool now commenced. The market for the unwrought material was limited, or for a while annihilated, and the British merchant had to depend solely on the cheapness and goodness of his fabric. Foreigners had now arrived in England, whose superior skill

* M'Culloch's Dict., art. 'Russian Company;' Anderson on Commerce, vol. ii. p. 123, and Chron. Rust. i. p. 98.

would put the value of the British fleece to a fair trial, by improving to a certain degree the cloth that had hitherto been offered, and by bringing forward other fabrics, and composed of another material, and on which the native manufacturer had not dared to experiment to the extent of which the combing-wool was capable. The same chronological order will be pursued, and with the exception of the Stuarts, who seemed to be aliens to our country and its interests, it will be an onward course of improvement that will be described.

In 1581 another body of merchants was incorporated, under the title of "The Turkish Company." Through their means all the commodities of Greece, Syria, Egypt, Persia, and India, came home to us at a cheaper rate than they had hitherto been procured, and a profitable as well as extensive market for the sale of British goods was opened. This Company likewise did much service to the woollen trade, but it was not so securely based as the other, and, for any efficient purpose, soon died away.

In 1582 the export trade in manufactured goods was nearly doubled: 200,000 pieces of cloth were shipped. Three-fourths of these were carried into Germany, and thence found their way into Poland, Denmark, and Sweden. A part was still conveyed to the Netherlands and to France. In fact, the English woollen fabrics were now carried to every part of Europe, and everywhere they found a profitable sale. The exportation of wool was for a while suspended, for the Netherlands were not yet sufficiently at peace: but this was a matter of little consequence, for, the native manufactures flourishing, there was less wool for the foreigner. The state of the trade soon had its natural influence on the cultivation of the sheep: the flocks of the farmer increased, and the fleece was better, and better prepared; and when the Continental market was again open it was supplied with wool as before.

The Barbary, afterwards called the African Company, was instituted in 1585, and, still later, the Levant Company. Both of them were advantageous to the woollen trade: they were for many years conducted as fairly and liberally as chartered associations of this kind could well be, and at length were abolished during the reign of George IV.

In 1589 the stocking-frame was invented by the Rev. William Lea of Cambridge. Previous to this, even the superior classes of society wore cloth hose—cloth fitted, and sometimes rudely so, to the leg, and either gartered, as in the case of the Countess of Salisbury, or laced or buttoned; or, for the men, the breeches reaching to and fitting the foot rendered a stocking unnecessary. Knitting was at length introduced, but the knowledge of it was confined to few persons; and hose of that manufacture were seldom seen. A pair of knit silk stockings, manufactured in Spain, was presented to Queen Elizabeth by her silkwoman. This princess, who was not deficient in personal vanity, would never afterwards wear any others. Every full-length portrait of her represents her as dressed in her high-heeled shoes and black silk knit hose *.

It is not improbable that regal vanity might have contributed somewhat to the total neglect of this mode of manufacturing woollen or silk hose;

* The well-informed author of the Treatise on the Manufacture of Silk is witty and severe about these black silk stockings: "It might have been supposed," he says, "that Elizabeth's inordinate fondness for dress would have induced her to give every encouragement to this manufacture; but, content probably with her own acquisition, she might become desirous that the more becoming silken texture should remain a regal privilege; and while she displayed her own ancles in the delicate silken knit, she was perhaps well pleased that her maids of honour should conceal theirs under the clumsy and inelegant cloth hose, lest haply, among these, some might have been found more beautifully formed than her own."—Lardner's Cabinet Cyclopædia, vol. xxii. p. 24.

but when the ingenious machine of Lea was invented, it is incomprehensible that it should not have met with a single patron. He established some looms at Colverton, near Nottingham, but no one gave him encouragement. He applied to the queen, and met with a rude rebuff. Was the ruling passion still strong even in old age? He then listened to the invitation of the French king, and carried his looms abroad, but Henry IV. was soon after sacrificed, and poor Lea died a beggar*.

Some of Lea's workmen returned to Nottingham and successfully established themselves and their looms there. Worsted hosiery is now chiefly made in Leicestershire, silk in Nottingham and Derby, and cotton also in these two counties, and at Hinckley and at Tewkesbury; 33,000 frames are supposed to be at work, and 3,510,000 dozens are made every year †.

In 1600 the East India Company was established, and it has ever been a staunch friend to the woollen-trade and the wool-grower. It had the power to open an almost boundless market for English woollen goods ‡. It early assumed, as the principle and guide of this division of its mercantile transactions, that, in the cloth which it exported, both the material and the manufacture should be British, and it has never deviated from this. When in 1828 Mr. Ireland, an extensive cloth manufacturer, was examined before the House of Lords with respect to the supposed deterioration of British wool, he said, "The East India Company is anxious to give as much countenance as they can to English growers, and they compel us to make some cloths entirely of British wool."

1608. James I. had now ascended the throne. The art of dyeing, as has been already seen, was perfectly known to the English manufacturer four hundred years before this date, but it had been utterly lost amidst the contentions by which the kingdom had been torn; and it was now the practice—a very strange one, when the woollen manufacture was in so flourishing a state in England—to send the white cloths into Holland to be dyed and dressed, and returned for sale. It was disgraceful, that they who surpassed all other countries in the fabric of the cloth, could not perform the finishing part at home. Some manufacturers and merchants reflecting on the great profit made by the Hollanders in this branch of the manufacture, (Sir Walter Raleigh states it to be 400,000*l.* per annum, and amounting, in the fifty-five years that it had continued, to nearly 20 millions of pounds,§,) and knowing also the king's profuseness, and his constant necessities, because he was unwilling to apply to the parliament for money, proposed to undertake the dyeing and dressing of the cloths on certain terms, leaving to the king the monopoly of the sale afterwards.

The proposition was a scandalous one, but James acceded to it, and issued a proclamation prohibiting the sending of any white cloths beyond the sea. The Hollanders and the Germans, as might be expected, resisted such a measure, and, in their turn, prohibited the importation of all dyed cloths. The speculator was therefore driven and confined to the home-market; but the cloths were not well dyed,—the charge for this bungling work was double what it used to be, and the project entirely failed.

* M'Culloch's Dict., art. 'Stockings.' † Ditto.

‡ Advantages of the East India Company are thus stated by Sir Joseph Childe:—"The East India Company takes off a considerable quantity of our native commodities and manufactures. It supplies us cheaply with the most necessary commodities for our own consumption; it brings us many commodities for our further manufacture; it furnishes us with large quantities of goods for foreign markets; it employs a great number of English shipping; it occasions the building of more ships of burden and force, fit for warlike services and the defence of the kingdom, than any other trade whatever; it brings in a considerable revenue to the king's customs, and the greatest addition to the kingdom's stock."

§ Sir Walter Raleigh's excellent Essay on Commerce.

The king was disappointed of his expected gains, and the English cloths were sent as heretofore to Holland to be dyed, and returned whence they came in order to be sold.

This, however, did not remain long. The folly and loss of such a proceeding was apparent to every mind, and the most strenuous efforts were made, and at length with a satisfactory result, to recall the lost art of dyeing.

In 1667 a dyer named Brewer came from the Netherlands with his workmen, and being well received and assisted by the government, he fully taught the English manufacturer the art of dyeing and dressing his white cloths, and thus made him perfectly independent of the Continent.

In the meantime, however, a very considerable improvement was made in the manufacture of woollen cloths by the invention of what are now called medley-cloths, different coloured wools being mixed together in the thread. Before this, the cloths had been of one uniform colour, and were dyed after they were woven. These medley-cloths were first made in Gloucestershire, and are still manufactured there in considerable quantities.

The woollen manufacture, although somewhat neglected by Elizabeth in the latter part of her reign, was left by her in a satisfactory and flourishing state. The greater part, or the whole of the wool which the country produced was employed in manufactures, either for home or foreign consumption; and one of the first acts of James was to prohibit the exportation of wool: but in the year 1622 there is the mortifying confession, under the sign manual, "that the cloth of this kingdom hath wanted both estimation and vent in foreign parts, and that the wools are fallen from their stated values, and trade in general is so far out of fame that the merchants and clothiers are greatly discouraged *".

The cause of this was, that the Hollanders and Flemings had been successful in their endeavours to revive their woollen manufacture, and many of the refugees had returned. There were continual contentions between the Merchant-Adventurers Company and the other traders and exporters; and in their eagerness to injure each other they sacrificed their common interest; and, most influential of all, from a false spirit of economy, and an erroneous view of the nature of their trade, they had refused to admit the superior foreign wools, which would now have improved their fabrics, and had bought up the coarse Irish and Scotch wools, by which their manufactures were deteriorated, and rendered almost unsaleable. James, an avaricious monarch, strangely magnified all these evils, that he might with better face impose new taxes upon his subjects in order to supply the supposed deficiency of the revenue.

In 1619 tapestry work was first brought into England by Sir Francis Crane, and James gave 2000*l.* for the building of a house at Mortlake, where this beautiful manufacture might be carried on †.

In 1625 Charles I. ascended the throne. He had fully as high ideas of his prerogative as his father possessed, and was more determinedly bent on upholding it; he, therefore, in the early part of his reign, had neither inclination nor time to patronize the manufacturing interest; and in the latter part of it, the trade and prosperity of the country were recklessly sacrificed by both the parties which were ranged against each other in unnatural contest. In the first year of his reign he too complained of the low state of wool, and the decay of the woollen trade; but he might be aiming at the object of his father—the increase of the revenue by new imposts.

* Rymer's Fœdera, vol. xvii. p. 40.
† Anderson on Commerce, vol. ii. p. 280.

The exportation of wool was forbidden. The prohibition was renewed five years afterwards, and it was ordained that all black cloths and mourning stuffs at funerals should be made from British wool alone. Two years afterwards, and after that, again and again, the prohibition against the exportation of wool was repeated with still severer penalties. This was a favourite object with the monarch; and he was determined to succeed. He likewise delivered up the whole of the trade to the tender mercies of the Merchant-Adventurers, and no manufactured goods were permitted to be sent to any other than their mart or staple towns; nor was any one allowed to trade within their limits under the penalty of forfeiture of their goods, unless they were freemen of the corporation. For these privileges the Merchant-Adventurers advanced at one time the sum of 30,000*l.* The woollen trade must have been a part and portion of the very life of the country, or it could not have survived, much less remained to a very high degree flourishing and lucrative under all these oppressions.

In 1646 the Sedan manufactory of fine cloth was established in France. It was patronized by the government; its founders were ennobled, and it flourished beyond all expectation. How striking a contrast with the abandonment, and treacherous sale of the staple, vital trade of Britain!

The Lords and Commons, when a six years' civil war had destroyed the power of the monarch, and crippled the resources of the kingdom, pursued the same course that Charles had commenced. "They wisely!" says Anderson, "and absolutely prohibited the exportation of English wool; they also issued a proclamation for supporting the privileges and charters of the society of the Merchant Adventurers of England, and our woollen trade at this time was in a very prosperous condition*."

The Commonwealth seemed disposed to take the woollen trade under its protection, but it was distracted by a variety of other objects, and little occurs in its short history which bears upon the present subject.

The reign of the second Charles commenced in 1660, and, as usual, with a proclamation against the exportation of wool and sheep, under the penalties of confiscation and imprisonment.

The second year of his reign, 1662, furnishes an unanswerable proof of the bad management of the commercial interests of the kingdom, and also of the expense and luxury which disgraced this reign.

| | |
|---|---|
| The imports amounted to . . . | £4,016,019 |
| The exports to . . . . . | 2,022,812 |
| Leaving a balance against the country of | £1,993,207 |

The continental governments took advantage of the supineness of the British, and in 1664 Colbert commenced a series of measures most injurious to the English commerce. He offered immunities and indulgences, and premiums and pensions to manufacturers and artists of every description, and from every country. A million of livres (50,000*l.*) were appropriated to the woollen trade alone. This plan could not fail of success. Numerous manufactories of fine cloth were established in Florence, and ere many years had passed, they were enabled to fabricate every kind of goods for which they were previously altogether dependent on the English.

In 1665 another pestilence occurred, equally fatal to the human being and the brute, and contributed yet more to depress the commerce of the country

A singular but unexceptionable law was instituted in the succeeding

* Anderson on Commerce, vol. ii, p. 406.

year, and which would cause the consumption of no inconsiderable quantity of woollen stuff:—" That every person should be buried in a shroud composed of wool alone, under the forfeiture of 5*l.* to the poor of the parish." This law continued in force about 130 years.

In 1667, as has been already stated, the art of dyeing was once more introduced into England. The account of the customs in 1668 shows that, if the British manufactories were not continuing to decline, the balance of trade was increasing against England.

| | £ | s. |
|---|---|---|
| The imports in that year were . | 4,196,137 | 17 |
| The exports . . . | 2,063,274 | 19 |
| Balance against England . | 2,132,864 | 18, nearly 140,000*l.* |

more than it was six years before.

This, however, is principally to be accounted for by the unlimited trade that was then permitted with France. Her wines and her silks were poured into England almost without limitation, while she received few or no goods from England in return. The ruinous tendency of this was sufficiently evident. The trade with France was curtailed, or in a manner prohibited; and on the following, and during several successive years, although our exports did not much increase, yet the balance was considerably in favour of England*.

The Hudson's Bay Company, which was established in 1670, had little influence on the woollen trade, except the opportunity which it afforded of getting rid of an inconsiderable quantity of coarse goods.

The woollen trade continued to decline, partly from the inexcusable neglect of the Stuart government, and partly from the inconsiderate efforts of the landed interest to force the price of wool so high as necessarily to drive the British manufactures from the foreign market; and, most of all, from the establishment of manufactories in every continental state, equal, and in some places superior, to those in England. The monopoly of the trading world, which the chances of the times, and the prudent management of Elizabeth, had given to England, and which was the principal jewel in her crown, was now in a manner lost. Many and loud were the complaints of the merchants; one of them gives the following account of the commerce of 1675, under Charles II.—" The Dutch, long after they became independent states, knew not how to manufacture many of our woollen goods, and the knowledge of which we ourselves had learned from the Flemings, driven out by D'Alva's persecution, and we supplied the Dutch with vast quantities of fine cloth also, though mostly white, which they dyed and dressed, and exported to Germany and many other parts. We had also formerly the sole trade to Denmark, Norway, Sweden, Livonia, Poland, and Prussia; our exports to all which northern countries are greatly lessened by the Dutch having set up mighty woollen manufactures, and the Flemings renewed theirs. We had formerly the sole trade of woollen clothing to France, to the value of 600,000*l.* yearly, but now none at all; also the sole trade to Turkey, but of late the Dutch are become our competitors therein, and the French have been long nibbling at this trade; and in the Spanish trade both the French and Dutch largely share with us. What is yet more grievous, we continue to import much fine cloth from the Dutch, yearly sent there to be dyed. Formerly we had the sole trade to Portugal, but now the French and Dutch are our competitors, as they are also to Italy, where we used to supply all. The Venetians also manufacture and vend much cloth there†."

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* King's British Merchant, vol. iii. p. 315, 316.

† Britannia Languens, p. 157.

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